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This report documents the second (additional) mapping program of the Direct/Delayed Response Project (DDRP) in the Northeastern United States. This survey of additional watersheds was conducted because of apparent sulfate retention by some watersheds based on data from the original DDRP Northeastern survey. The objectives of this report are to document the methods, field operations, and quality assurance/quality control (QA/QC) of the mapping. The protocols, QA plan, and soil legend for the watershed mapping are presented as appendices.

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DIRECT/DELAYED RESPONSE PROJECT:
FIELD OPERATIONS AND QUALITY ASSURANCE REPORT FOR ADDITIONAL WATERSHED MAPPING IN THE NORTHEASTERN REGION OF THE UNITED STATES

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EXECUTIVE SUMMARY

The Direct/Delayed Response Project (DDRP) of the National Acid Precipitation Assessment Program is a United States Environmental Protection Agency (USEPA) program to reduce the uncertainties in current understanding of the effects of acidic deposition on surface water chemistry. The response of watersheds to acidic deposition is being assessed for selected study regions using data from DDRP watershed surveys, USEPA surface water surveys, and acidic deposition data. This document describes the planning activities, methods, field activities, and the quality assurance/quality control (QA/QC) operations associated with watershed mapping in the Northeastern United States. The watersheds mapped were chosen from those studied by the USEPA National Surface Water Survey and they were selected because of their apparent sulfur retention based on data from the original DDRP Northeast watershed survey.

These mapping activities produced soil, depth-to-bedrock, landuse, forest cover type, and drainage/water features maps of 44 watersheds. Soil map quality guidelines were based on those of the National Cooperative Soil Survey with minor modifications. Modifications were documented in DDRP mapping protocols which are included as Appendix A. The intensity of the mapping is order two. The map scale is 1:24,000 with minimum map delineations of two acres for hydric soils and soils formed in alluvium, and six acres for all other soils.

The mapping protocols were slightly revised from previous DDRP surveys prior to beginning the fieldwork. Comparability between DDRP surveys was promoted by using basically the same protocols throughout the project. The soil scientists who conducted the mapping either participated in protocol training sessions, or they were already familiar with the protocols from participation in the original DDRP Northeast survey. A correlation and mapping review workshop was held after the mapping was completed to correlate the soil legend (Appendix B) and to complete work on map unit descriptions. An exit meeting was held as part of the workshop to review field activities, to evaluate the adherence to protocols, and to make recommendations for similar future surveys.

The QA/QC procedures were outlined in a QA plan that is included as Appendix C to this report. Field reviews conducted by US Department of Agriculture, Soil Conservation Service (SCS) State Soils Staffs, field reviews by a DDRP Regional Coordinator/Correlator (RCC), and independent map quality evaluations by the RCC provided QC during the field mapping. Mapping quality and adherence to the protocols were evaluated during these reviews. The field reviews evaluated mapping quality and answered questions from soil scientists concerning the protocols. No major problems were identified during the SCS field reviews and no mapping was rejected. The choice between several similar map units, the size of delineations, and the addition of soil map units to the legend were most commonly discussed during the reviews.

The RCC conducted independent quality evaluations of final maps for 9 of the 44 watersheds. Minor map revision was needed for 2 of the 9 watersheds. All nine watersheds were judged as acceptable after revision. Discrepancies and comments resulting from the evaluations included a map unit complex that should have been a consociation, consociations that should have been complexes, soils that were taxadjuncts to named series, the need to add some stony or bouldery map units to the legend, incorrect slope classes, a few instances where hydric soils less than six acres should have been mapped, and mistakes in naming map unit complexes, which were all corrected. The report by the RCC summarizing his activities and findings is included as Appendix D.

Quality evaluations by DDRP soil scientists and geographers at the USEPA Environmental Research Laboratory - Corvallis, provided a final check to ensure that correct data were digitized. It is crucial that mapping data be corrected before digitizing and that data be accurately entered into the geographic information system. Apparent discrepancies, such as inconsistent watershed boundaries, depth-to-bedrock maps that did not correspond to soil maps, insufficient written documentation, missing symbols, stream placement, whether streams are intermittent or perennial, and potential water contamination, were discussed directly with the field soil scientists and the SCS State

Soils Staffs. Discrepancies were resolved and the maps were digitized. The quality of digitization work was also checked. Soil transect data were statistically analyzed to determine a quantitative estimate of the quality of the mapping.

The overall conclusion of the QA/QC activities is that the mapping is of sufficient quality for the DDRP. The completeness goal of mapping 100 percent of the preselected watersheds was achieved. The goal for completeness of field documentation was achieved. The SCS State Soil Staffs' field reviews and map evaluations found no significant problems with the mapping. The RCC's overall conclusion was that the mappers did a very thorough and careful job and that, based on 20 percent of the watersheds, the mapping meets the requirements of the DDRP protocols. Statistical analyses of the transect data did not suggest any problem with the mapping and map unit composition estimates.

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1 INTRODUCTION

This report documents the second (additional) mapping program of the Direct/Delayed Response Project (DDRP) in the Northeastern (NE) United States. This survey of additional watersheds was conducted because of apparent sulfate retention by some watersheds based on data from the original DDRP NE survey. The objectives of this report are to document the methods, field operations, and quality assurance/quality control (QA/QC) of the mapping. The protocols, QA plan, and soil legend for the watershed mapping are presented as appendices.

PROJECT DESCRIPTION

The DDRP is an integral component of the acidic deposition research program of the United States Environmental Protection Agency (USEPA) conducted under the federally mandated National Acid Precipitation Assessment Program (NAPAP). The DDRP is managed by the USEPA Environmental Research Laboratory - Corvallis (ERL-C). The general goal of the DDRP is to reduce the uncertainties in current understanding of the effects of acidic deposition on surface water chemistry. The response of watersheds to acidic deposition is being assessed for the study regions of the NE Region, the Southern Blue Ridge Province (SBRP), and the Mid-Appalachian Region (Figure 1-1) using data from DDRP watershed surveys, results from the National Surface Water Survey (NSWS), and deposition data.

The four technical objectives of the DDRP related to atmospheric/terrestrial/aquatic interactions (Church et al., 1989) are:

(1) to describe the regional variability of soil and watershed characteristics,

(2) to determine which soil and watershed characteristics are most strongly related to surface water chemistry,

(3) to estimate the relative importance of key watershed processes in moderating regional effects of acidic deposition, and

(4) to classify a sample of watersheds with regard to their response characteristics to inputs of acidic deposition and to extrapolate the results from this sample of watersheds to the study regions (Figure 1-1).

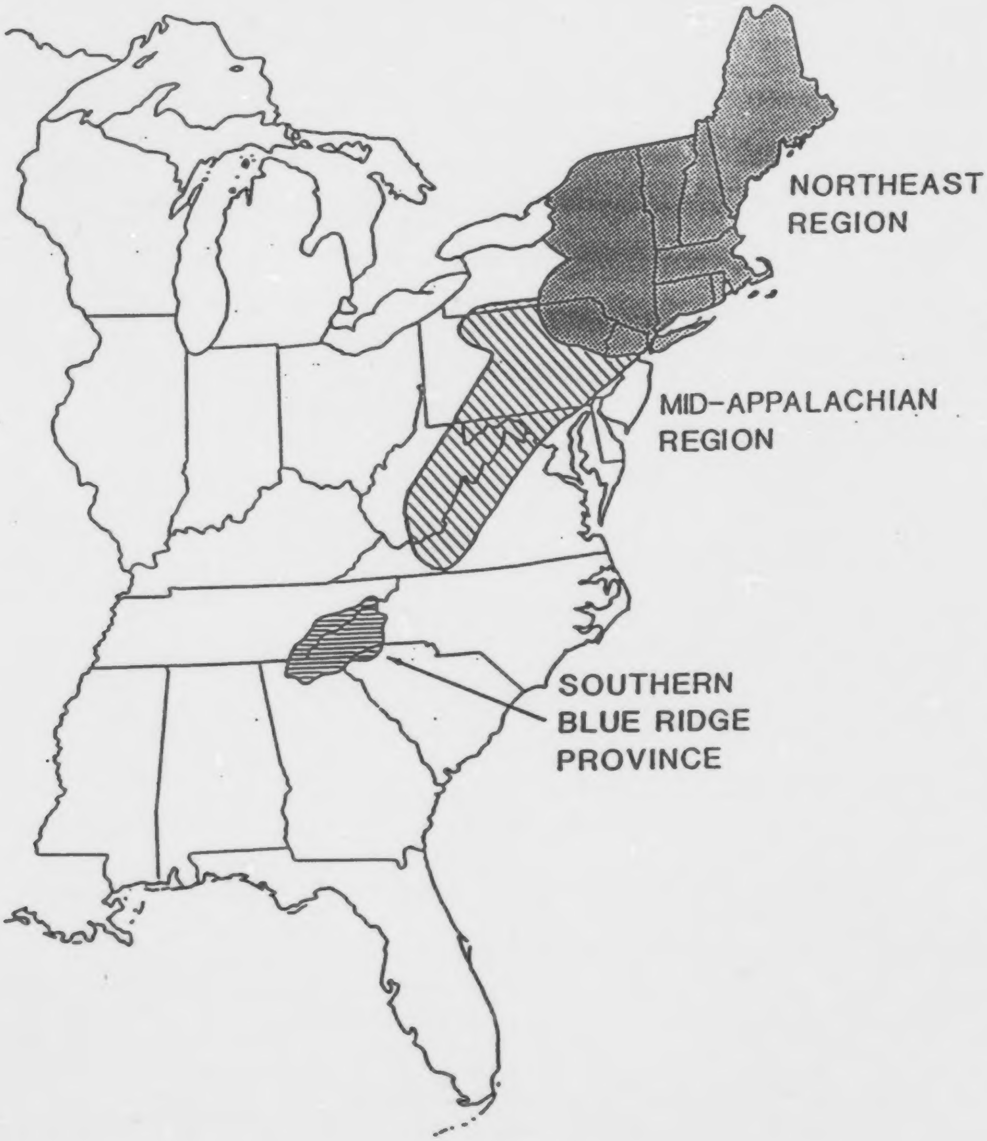
NORTHEAST
REGION
MID-APPALACHIAN
REGION
SOUTHERN
BLUE RIDGE
PROVINCE

Figure 1-1 Study Regions for the DDRP

Three increasingly complex levels of data analysis are being be used for the assessment (Church et al., 1989): Level I - system description and statistical analysis; Level II - single factor response-time estimates; and, Level III - dynamic systems modeling.

Level I analyses include statistical procedures such as cumulative distribution functions, cluster analyses, or other multivariate procedures, and steady-state calculations such as sulfur input-output budgets, watershed indices, and equilibrium chemistry predictions. These analyses are being integrated with available data on watershed characteristics to correlate ranges of variables that influence long-term watershed response to sulfur deposition.

Level II analyses represent order-of-magnitude time estimates for the rate of change of important watershed responses (e.g. time to steady state sulfate adsorption). These analyses will be used to estimate the rate of change of individual processes theorized to be important in controlling surface water acidification.

In Level III analyses the dynamic watershed models used are the Model of Acidification of Groundwater in Catchments (MAGIC) (Cosby et al., 1985a; Cosby et al., 1985b; Cosby et al., 1986a; Cosby et al., 1986b), Integrated Lake-Watershed Acidification Study model (ILWAS) (Chen et al., 1983; Gherini et al., 1985), and Enhanced Trickle-Down (ETD) (Lee, 1987; Nikolaidis, 1987; Schnoor et al., 1986). The models integrate the key mechanisms controlling surface water chemistry, including soil contact, weathering, anion retention, and base cation buffering, and will be used to project changes in water chemistry in response to scenarios of long-term sulfur deposition.

The goal of the watershed survey is to provide soil and other watershed attribute data for study regions in the DDRP. Watershed surveys have been completed in the NE Region, with the supplemental mapping in selected additional watersheds described here, the Southern Blue Ridge Province (SBRP), and the Mid-Appalachian Region. An overview of DDRP watershed survey activities is given by Lee et al. (1989a) and the results of the DDRP research in the NE and SBRP are presented by Church et al. (1989). Soil sampling was a phase of all the DDRP surveys except for these additional NE watersheds.

The specific objectives of the DDRP watershed surveys are to:

- characterize the variability of soil chemical and physical properties in watersheds of study regions, and
- provide data on other watershed characteristics (e.g. depth-to-bedrock, landuse, forest cover, drainage, water features and bedrock geology) across the study regions.

WATERSHED SELECTION

Forty-four watersheds, in addition to the original DDRP NE watersheds, were chosen for mapping from the watersheds in subregions 1A, 1B, 1C, 1D, and 1E of the Eastern Lakes Survey (ELS) (Best et al., 1986) (Figure 1-2) of the National Surface Water Survey (NSWS). The selection was based upon 1984 water-year data and preliminary watershed sulfur input-output budget data. The watersheds selected had minimal anthropogenic disturbances, contain drainage or impoundment type lakes, have an area of < 3,000 ha, and met at least one of the following criteria:

- at least 20 percent sulfur retention,
- $\geq 20\ \mu\text{eq}\ L^{-1}$ difference between lake sulfate and steady state sulfate concentrations, and
- lake sulfate concentrations ranked at, or below, the tenth percentile of sulfate concentrations for their ELS subregion.

The locations of the watersheds that were mapped are listed in Table 1-1.

DESIGN OF THE MAPPING ACTIVITIES

DDRP mapping activities describe the spatial variability of soils, depth-to-bedrock, landuse, forest cover type, and drainage/water features. The protocols for the mapping activities are included in this report as Appendix A.

Soil Mapping

The procedures and quality requirements of the soil mapping are primarily based on those of the National Cooperative Soil Survey (NCSS). Federal leadership of the NCSS is provided by the US Department of Agriculture, Soil Conservation Service (SCS). The mapping standards are defined in

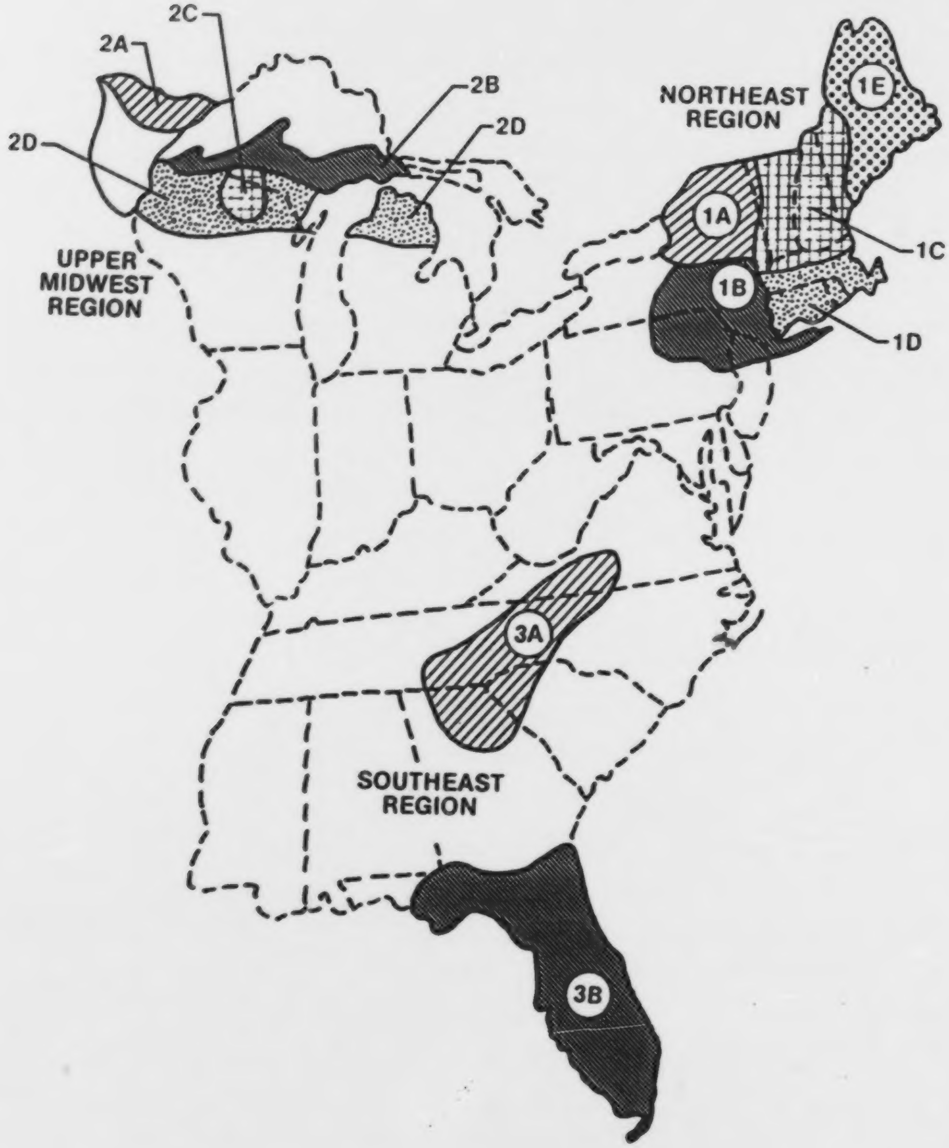
2C
2A
2B
2D
2D
UPPER MIDWEST REGION
NORTHEAST REGION
1E
1A
1B
1C
1D
3A
SOUTHEAST REGION
3B

Figure 1-2 Subregions of the USEPA Eastern Lakes Survey
(Figure 1 from Best et al., 1986)

Table 1-1 Locations and Mapping Leaders for the DDRP Additional Northeast Watersheds

ID Number	Watershed Name	State	Latitude	Longitude
			(decimal degrees)	
1A1019	Quiver Pond	NY	43.7375	74.8708
1A1037	Black Pond	NY	44.1500	74.5917
1A2001	Twin Ponds (Eastern)	NY	43.6722	74.1722
1A2036	Lily Pond	NY	43.7042	73.6708
1A2038	Cod Pond	NY	43.5167	74.1417
1A2056	Huckleberry Lake	NY	43.7964	75.2500
1A2057	Twin Pond (Northwest)	NY	44.7067	74.3425
1A3018	Sullivan Pond	NY	43.6333	73.8194
1B1004	South Mountain Lake	PA	41.6250	76.7556
1B1006	Lake John	PA	41.4305	76.2708
1B1007	Lopez Pond	PA	41.3972	76.3911
1B1008	Rouse Pond	PA	41.4264	76.2875
1B1038	Goose Pond	PA	41.2528	75.1944
1B1050	Indian Mountain Lake	PA	41.0053	75.5056
1B2048	Wolf Swamp	PA	41.0458	75.4000
1B2059	Mud Pond	PA	41.3836	75.5264
1B2069	Boyle Pond	PA	41.1697	75.9250
1B3003	Triangle Lake	NY	42.5333	74.2042
1B3013	Stump Pond	NY	41.8375	74.9000
1B3029	Jacox Pond	NY	41.4444	73.9236
1B3068	Holp Pond	NY	41.8786	74.9994
1C1046	Shaws Pond	NH	43.5333	71.1417
1C1069	Hidden Lake	VT	42.8806	72.7194
1C2055	North River Pond	NH	43.1958	71.1292
1C2061	Great Hill Pond	NH	43.8889	71.3333
1C3034	Hansen Pond	NH	43.5958	70.9083
1D1007	Dean Pond	MA	42.3458	72.0250
1D1011	No Name	MA	42.0500	73.2208
1D1021	Tippecansett Pond	RI	41.5972	71.7833
1D1058	Griggs Pond	CT	42.0019	72.0872
1D2006	Ames Pond	MA	42.4978	72.4192
1D2013	Benedict Pond	MA	42.2042	73.2875
1D2087	Cusky Pond	MA	42.3236	72.0922
1D3004	Crocker Pond	MA	42.5278	71.8542
1D3083	Lake Floren	CT	41.7569	73.2425
1E1010	Six Ponds	ME	46.0083	68.9250
1E1017	Weed Pond	ME	46.0333	68.8750
1E1023	Gardner Pond	ME	46.0744	68.6650
1E1036	Crooked Brook Lake	ME	45.5500	67.7208
1E1060	Bracey Pond	ME	44.9625	68.1222
1E1072	Schoodic Lake	ME	44.6958	67.8917
1E1097	Upper Oxhead Pond	ME	45.0819	68.2544
1E2004	Lost Pond	ME	46.2167	69.3472
1E2046	Rich Mill Pond	ME	46.2167	69.3472

the National Soils Handbook (Soil Survey Staff [SSS], 1983). Soils in this survey were classified according Soil Taxonomy which is the soil classification system used by the NCSS (SSS, 1988; SSS, 1975). The final soil legend is included as Appendix B of this report.

The intensity of this soil survey is order two, as defined by the SSS. This means that each map delineation was identified by traversing it and that the type of map units used were consociations, complexes and, occasionally, undifferentiated groups (SSS, 1983). In this survey the map scale is 1:24,000. The minimum size of delineations is about 6 acres and 2 acres for hydric soils and soils formed in alluvium. Small features, such as gravel pits and rock outcrops, were represented by special symbols.

Soil map units are representations of naturally occurring segments of the landscape that are delineated on a map. Specifications of map units can be found in the National Soils Handbook (SSS, 1983). Map units are described in terms of geomorphic characteristics and the relative proportion of soil and/or miscellaneous area components that occur within map delineations.

The soil map units were described by the following characteristics;

- regional landform,
- local landform,
- geomorphic position,
- slope configuration, and
- percent composition of map unit components.

The soil components, that comprise map units, were described by the following characteristics;

- phase (e.g., slope, texture of the surface layer, surface stoniness),
- drainage class,
- permeability class,
- parent material, origin, mode of deposition,
- depth-to-bedrock, and
- taxonomic classification.

Depth-to-Bedrock Mapping

Soil scientists prepared depth-to-bedrock maps by combining contiguous delineations of soil map units with the same depth-to-bedrock class. Depth-to-bedrock estimates were determined by examination and observation of soil profiles, roadcuts, excavations and stream incisements. The mapping was transferred by field soil scientists to mylar overlays on US Geological Survey (USGS) quadrangles or orthophotoquads at a scale of 1:24,000. One to three depth classes were assigned to each map delineation. The depth-to-bedrock classes reflect major soils in the delineation, not map unit inclusions. The depth-to-bedrock symbol for a map delineation lists the depth-to-bedrock classes in descending order of estimated extent. Where appropriate, soil map delineations were segmented into more than one depth-to-bedrock class. The depth-to-bedrock classification is different than the soil depth classes used by the NCSS (SSS, 1983). A comparison of the two systems is presented in Table 1-2. Delineations of depth-to-bedrock classes I, II, and III are expected to have a higher level of confidence than deeper classes because of the difficulty of excavating by hand deeper than two meters (Appendix A).

Landuse and Forest Cover Mapping

Landuse/forest cover maps of each watershed were prepared by soil scientists from field study and aerial photograph interpretation. The mapping was transferred to mylar overlaying USGS quadrangles or orthophotoquads at a scale of 1:24,000. Landuse was designated by the landuse code types used on the SCS computer entry Soil Description Form. Forest cover types were those of the Society of American Foresters (Eyre, 1980).

Drainage Mapping

Drainage features maps were prepared on mylar overlaying USGS quadrangles or orthophotoquads at a scale of 1:24,000. Standard map symbols shown in the mapping protocols (Appendix A) were used to delineate all perennial streams, dominant (well-defined) intermittent streams, water bodies and other water features. Marsh or swamp symbols were used to define areas less than

Table 1-2 Comparison of DDRP and SCS Depth-to-Bedrock Classes

Depth (meters)	DDRP Class	SCS Class
0 - 0.25	I	Very shallow
0.25 - 0.50	I	Shallow
0.50 - 1.0	II	Moderately deep
1.0 - 1.5	III	Deep
1.5 - 2.0	III	Very deep
2.0 - 5.0	IV	Very deep
5.0 - 30.0	V	Very deep
> 30.0	VI	Very deep

two acres with standing water; larger marsh or swamp areas were delineated on the overlay and labelled "S". The upper end of perennial streams are marked with a short red lines across stream symbols. If a USGS topographic map was used, care was taken to make any corrections to changes in drainage since the original map was prepared.

Transects

The field soil scientists and the Regional Coordinator/Correlator (RCC) conducted transects within map unit delineations that recorded the map unit name, location, transect length, and transect interval. A brief profile description and the series name were recorded for each transect stop. Soil scientists identified at least one transect for each map unit delineation. Additional transects were identified at a rate of 1 transect for each 160 acres in large map units. The transects were chosen to represent the typical landscape of the area delineated and usually were oriented perpendicular to the drainage pattern. Soil scientists conducted 1 transect for each kind of map unit if there were 10 or less different kinds of map units in each watershed. In watersheds with more than 10 different kinds of map units, 10 transects plus 1 additional transect for every two additional kinds of map units were conducted. More details about transects are presented in the mapping protocols (Appendix A).

The RCC conducted transects on 9 of the 44 watersheds. The Mapping Task Leader selected the map units for the RCC to transect in order to have data from both the soil scientist doing the mapping and the RCC for the same map units. A statistical evaluation and comparison of the transect data are presented in Section 4. A discussion of the results of the RCC transects is given in the report of the RCC (Appendix D).

2 PROJECT QUALITY ASSURANCE (QA) ORGANIZATION AND RESPONSIBILITY

PROJECT ORGANIZATION

The Mapping Task Leader from ERL-C had overall responsibility for the field activities and the documentation of methods, field operations, and data quality. The Mapping Task Leader maintained the mapping information database that contains the identification legend, the classification, and description of map unit composition.

The RCC was an independent contractor who provided QA/QC oversight for the fieldwork. The RCC maintained a uniform, consistent regional mapping legend [illegible]articipated in at least one field review for each state as an audit of field mapping procedures and mapping quality, and evaluated the quality of the mapping in 20 percent of the watersheds.

The SCS State Soil Scientists for ME, NY, and PA, with the support of the State Soils Staff, were responsible for the field activities by personnel from their state. This included supervising and coordinating field crews, conducting at least one progress field review as an audit of each soil survey party, working with the RCC to ensure regional consistency, forwarding completed maps with field notes to the Mapping Task Leader, and participating in training field crews.

The DDRP ERL-C QA Coordinator worked with the QA Staff of ERL-C to coordinate and document QA/QC activities. The QA Coordinator evaluated final map quality with the Mapping Task Leader, helped coordinate the QA/QC activities of ERL-C geographers, and was responsible for the preparation of the Field Operations and QA report.

The Soil Survey Parties, led by a soil scientist, mapped the watersheds, described soils and soil map units, and conducted transects across map delineations to determine map unit composition.

PROJECT RESPONSIBILITY

Soil Survey Parties

The soil scientists assigned to conduct the mapping had the following responsibilities:

- conducted field investigations and aerial photo interpretation in order to delineate map units,
- traversed or visited all map delineations in the field,
- recorded observations and problems systematically in field notes, and

- conducted randomly selected transects used in the determination of soil map unit composition.

USDA-SCS State Soils Staffs

The State Soils Staffs had the following responsibilities:

- maintained a uniform and controlled legend by coordinating and correlating soils and map units,
- trained soil survey parties in and supervised adherence to the mapping protocols,
- conducted field reviews that were to include at least one watershed for each mapper,
- reported and resolved mapping problems in an expeditious and uniform manner,
- conducted follow-up reviews to ensure that any necessary corrective actions had been taken,
- prepared reports presenting results of the above tasks, and
- reviewed mapping products and sent the products to ERL-C.

Regional Coordinator/Correlator (RCC)

The Regional Coordinator had the following responsibilities:

- maintained a uniform and controlled legend by coordinating and correlating soils and map units,
- participated in training,
- conducted transects on selected map units to evaluate the correctness of the mapping,
- evaluated mapping on about 20 percent of the watersheds by aerial photography interpretation and field investigations,
- participated in at least one progress review for SCS personnel in each state,
- evaluated state field review reports (Appendix D), and
- prepared reports presenting the results of the above tasks.

Mapping Task Leader

The Mapping Task Leader had the following responsibilities:

- managed and directed the mapping,
- worked with the DDRP ERL-C QA Coordinator to coordinate and document QA/QC activities,
- developed mapping protocols,
- provided initial instruction on mapping activities,

- evaluated progress reviews,
- coordinated with the SCS and the RCC to ensure that any necessary corrective actions were taken to resolve identified problems,
- selected watersheds and transects to be evaluated by the RCC,
- received and stored all interim and final reports, maps and other products,
- supervised final map checks and corrective actions before maps were digitized, and
- maintained the mapping database.

QA Coordinator

The DDRP ERL-C QA Coordinator had the following responsibilities:

- prepared the QA Plan,
- evaluated final map products,
- coordinated review of final map with geographers,
- worked with the ERL-C QA Staff to ensure that QA requirements were being fulfilled
- facilitated the exit meeting, and
- prepared the Field Operations and QA Report.

3 SOIL MAPPING OPERATIONS

PREPARATION FOR FIELD MAPPING

Preparations made before the initiation of field work included the development of protocols, a preliminary soils legend, the schedule of field work, and the contracting with qualified personnel to conduct the mapping. The preliminary legend was developed from the original DDRP NE mapping. The Mapping Task Leader was responsible for the planning and monitoring of the mapping operations.

Development of Mapping Protocols

The mapping protocols (Appendix A) were first developed for the 1985 DDRP NE mapping, and were revised for the DDRP SBRP and for the additional NE mapping. The protocols used for this mapping were the same as used in the DDRP Mid-Appalachian watershed survey. The protocols have remained largely unchanged throughout the DDRP surveys and were all based on NCSS guidelines. The minimum size delineation for hydric soils and soils formed in alluvium is 2 acres; whereas, in the original NE and SBRP surveys the minimum delineation for all kinds of soils was 6 to 10 acres. The original DDRP NE mapping did not include landuse mapping by survey parties. The procedures for locating and selecting transects are different in all the versions of the protocols. In the NE survey, transects were conducted across entire watersheds passing through as many delineations as possible with 33 m intervals for recording observations. The total number of observations depended on the watershed area: <500 acres, 50 observations; 500 to 1,000 acres, 75 observations; 1,000 to 2,000 acres, 100 observations; and >2,000 acres, 150 observations (Lammers et al., 1987a). In the SBRP survey the protocols stated that the RCC would randomly select the delineations for transecting for each kind of map unit after 80 percent of the mapping was complete. Transects were located perpendicular to the drainage pattern and crossed most of the delineation. There were ten evenly spaced observations for each transect (Lammers et al., 1987b). In this survey and the Mid-Appalachian survey, the delineations for transecting were selected by the field soil scientists. Soil scientists conducted 1 transect for each kind of map unit if there were 10 or less different kinds of map units in the watershed. Watersheds with more than 10 different kinds of map units had 10 transects plus 1 additional transect for every two additional kinds of map units. The change of transect procedures between surveys has no effect on data quality. The mapping itself was conducted similarly but the change in transect procedure gave a slightly different perspective about the quality of the data.

Mapping Personnel and Training

The survey was implemented through interagency agreements between the USEPA and the SCS. The SCS was chosen because it has a staff of trained soil scientists, located in the study region, who have experience producing maps according to NCSS guidelines. The SCS State Soil Scientists for NY, ME, and PA prepared work plans to arrange for personnel and equipment to carry out the mapping. The soil scientists from ME mapped watersheds in CT, MA, ME, NH, RI, and VT.

There was no single training session for all of the participants for this survey. One of the two soil scientists from PA went to a mapping training session held for the DDRP Mid-Appalachian survey which used the same protocols. This person then provided on the job training in the mapping protocols to the other PA soil scientists. Both of the PA soil scientists were familiar with the protocols because they had worked on the original DDRP NE mapping. Most of the NY soil scientists who mapped for this survey had been involved in the original NE DDRP mapping. The ME soil scientists had also been involved in the original DDRP NE mapping. Field soil scientists and State Soils Staffs received additional training during an initial field visit by the RCC during which changes to the protocols were discussed.

FIELD MAPPING AND COMPILATION

Mapping activities were initiated in the Fall of 1987 and were completed in the Summer of 1988. The mapping in NY was conducted by several different combinations of State Soils Staff and field soil scientists, depending on the scheduling priorities of the SCS. The mapping by ME personnel was done primarily by two soil scientists, experienced in DDRP methods, who mapped watersheds in ME individually and together in CT, MA, NH, RI, and VT. The mapping in PA was conducted by two soil scientists who mapped independently.

Map compilation and cartography was conducted by the field soil scientists in ME and PA. Final maps from NY were drafted by one soil scientist from the SCS State Soils Staff. Aerial photographs of each watershed at a scale of 1:24,000 were produced for this project with color-infrared and black-and-white prints. Film positives of USGS 7.5-minute topographic quadrangles or enlarged 15-minute quadrangles, when 7.5-minute quadrangles were not available, were used as a rectified map base. Maps were checked by for accuracy and completeness by the State Soils Staff and were checked again at ERL-C. Maps were digitized from a rectified map base and entered into a computerized geographic information system (GIS). Map digitizing was completed before the soil correlation workshop and provided exact measurement of the extent and occurrence of every map unit.

CORRELATION OF THE SOILS AND SOIL MAP UNITS

Soil correlation is the process of maintaining consistency in naming, classifying, and interpreting soils and units delineated on maps. There are two main elements of soil correlation; first, the correlation of an individual soil pedon or groups of soil pedons with a soil series, or with some higher level soil taxonomic class, and second, the correlation of map units. Correlation requires consistent methods of observation and measurement among all participants, as well as the use of consistent conventions and terminology. The Soil National Soils Handbook (SSS, 1983) and Soil Taxonomy (SSS, 1975; SSS, 1988) provide the conventions and guidelines for defining and naming map units, and for defining diagnostic properties and taxonomic classes of soils used in the NCSS. Soil series are described by SCS Official Soil Series Descriptions (SSS, 1983).

Correlation During Mapping

The soil scientist responsible for mapping each watershed performed the first level of correlation of the soils and map units. The descriptions of official soil series were adopted to represent those soil series for the region. At points along a traverse, the soil was examined and evaluated for characteristics that were within the range of a soil series or that were similar to an established series. Soils with properties outside the range of established soil series were classified at the family or higher taxonomic level. Brief descriptions were made of the different kinds of soil to document what was observed and to compare or correlate with the Official Series Description or other field descriptions. The descriptions of the different recognized kinds of soil were further evaluated by the State Soils Staff during progress field reviews for consistent correlation within each state.

In addition to the proper recognition and classification of soils observed, the soil scientist also determined the relative proportion of each kind of soil on a landscape segment. In this manner, soil map units were defined. The soil scientist then correlated the composition of soils with one of the map units in the preliminary legend or proposed an additional map unit. The map units were reviewed by the State Soils staff to correlate map units on all watersheds within each state. The RCC controlled the mapping legend and correlated soil map units throughout the region.

Correlation and Mapping Review Workshop

The soil correlation and mapping review workshop was held November 14 to 17, 1988 at ERL-C. The objective of the correlation segment was to produce a correct and consistent mapping database. This included correlation of soils and of map units, resolution of map unit composition, completion of missing data, verification of soil and map unit data, and correction of map discrepancies.

Soil Identification Legend --

Prior to the workshop, all soil map symbols and their corresponding acreages from digitized soil maps were compared with all map symbols listed in the updated preliminary soils legend. Map symbols not used in the mapping were deleted from the preliminary legend and map symbols not in the preliminary legend were added.

The resulting correlation legend, listing map symbols, acres of each map unit and map unit names, was printed for review by the workshop participants. A separate print-out listed map symbols and acreages of each map unit by the watershed on which they occurred. This list was used to locate the watershed(s) on which a map unit was mapped and to record corrections resulting from correlation decisions made by the workshop participants. Corrections recorded on the list were then corrected in the digitized data.

During the workshop about 20 map units were combined with other map units and deleted from the legend. Most of these map units were of small extent (less than 20 acres) and similar to another map unit in the legend with which it could be combined. As an example, map unit 120C, Merrimac sandy loam, 8 to 15 percent slopes, with 13 acres, was combined with 120B, Merrimac sandy loam, 0 to 8 percent slopes, a map unit that was similar except for slope gradient, with 135 acres.

Where an area mapped in one watershed did not match the properties of delineations denoted with the same map unit in the rest of the region, the area was correlated to another map unit. Five changes of this type were made; three of them were changed to other map units in the legend and two resulted in new map units being added. For example, the 25.7 acres of map unit designated by map symbol 107A (Lyme fine sandy loam) in watershed number 1C2061 changed to map symbol 32A (Brayton) because of pH.

The map unit for island, 995Z, was removed because of its small size (0.5 acres) in watershed 1A1037 which added to the area to the area of water. An additional 19 changes were made in the map unit names. Many of these resulted from a surface stoniness phase name (e.g. stony) being added or deleted. A new map unit and map symbol, as required by NCSS convention, was needed for three of these name changes. As an example, 387F was added to the legend as a bouldery phase of 215F (Tunbridge-Lyman fine sandy loams, 45-70 percent slopes).

After the workshop, the changes recorded on the correlation legend and map unit/watershed list were corrected in the digitized data file and mapping database file. The two files were then compared, two minor discrepancies were corrected, and the final legend was printed from the database file. Upon further review of field notes following the workshop, soil scientists with SCS in ME submitted additional proposed changes. Resolution of the proposed changes resulted in two more changes which were corrected in the GIS and database files. The final legend is included in this report as Appendix B.

Map Unit Composition --

The next topic of concern addressed by the workshop participants was map unit composition. The composition of major soil, minor soil and miscellaneous-area components in each map unit was estimated to the nearest five percent. Initial estimates of map unit composition were from the original DDRP mapping in the NE region. These were revised during field mapping by individual soil scientists and within states before the workshop. Transect data summarized by map unit across the region was used to estimate the map unit composition. Soil scientists used field notes and knowledge gained by observations during field mapping to adjust map unit composition as necessary.

The corrections to map unit composition were recorded on map unit worksheets (Figure 2-1, Appendix A) that had been generated from the mapping data management system before the workshop and corrected in the database file during the workshop. Map units that were deleted from the legend were removed from the map composition file and the file was checked for completeness. The file was checked to see that the composition for each map symbol in the final legend was described and that the total of all components in a map unit was equal to 100 percent.

Map Unit Components --

Every unique map unit component recognized in the map unit composition file was assigned a code (SCODE) and each of these soils or miscellaneous areas was listed in the soil component file along with selected soil characteristics and the soil taxonomic classification. Soil properties recorded in this file along with the soil name, texture, slope and other phase(s) included permeability, drainage, mode of deposition, origin of parent material, depth-to-bedrock, and depth to a slowly permeable or impermeable layer. Codes of the appropriate sampling class to which the soils had been assigned from the previous NE mapping were also recorded in this file. The initial soil component file resulted from the original NE mapping and records were added as needed during the field mapping. Soil components not used in the composition file were deleted from the components file by comparing SCODE's and deleting those with no area mapped. Components were added during the workshop using the mapping data management system and a print-out of the file was examined for completeness and discrepancies.

The taxonomic classification of each soil series was checked against the SCS National Soil Series Classification List or the most recent copy of the SCS Official Series Description. The assignment of each soil component to a soil sampling class, defined for the initial DDRP NE soil survey, was reviewed and additional soils, those not mapped in the initial survey, were assigned to classes. Soils on parts of two watersheds in PA were on landscapes that had not been glaciated. These soils, therefore, were correlated to sampling classes defined for the DDRP Mid-Appalachian region.

Landscape Attributes of the Map Units --

Selected landscape attributes of map units were recorded in the map unit file. These included regional landform, local landform, geomorphic position, slope shape across, and slope shape down. A print-out of these attributes along with the map symbol and map unit name was reviewed and corrected or completed as necessary by soil scientists from the state responsible for the map unit. Corrections and additions were entered into the data file and the file was again listed and reviewed.

Soil Map Unit Transects --

Data for 385 soil map unit transects, conducted by SCS soil scientists and 61 conducted by the RCC, were entered into a transect data file prior to the workshop. Transects were identified by watershed number, soil map symbol, and transect number. The transect number corresponded to the number assigned to each available transect (one or more for each delineation) for a map unit in a watershed. For each of the ten equally spaced stops along the transect, the soil name, slope gradient and additional notes were entered into the data file. The soil at each stop was assigned to a sampling class by relating the soil name to the same soil name in the components file and replacing the corresponding sampling class code in the transect file with the sampling class code from the components file. In this manner, misspelled soil name entries and soils not in the components file were identified by occurrences of missing data in the sampling class field of the transect file. These data were reviewed and corrected on the print-out of the transect file by soil scientists representing each state. Corrections to the transect data file were not made until after the workshop and any remaining discrepancies were resolved by the Mapping Task Leader and field soil scientists.

Landuse/Cover Type Mapping Evaluation --

SCS soil scientists prepared overlays of landuse/cover type by field observation and aerial photography interpretation during the course of mapping. Landuse, wetlands, and watershed boundary maps were prepared independently from office photointerpretation of color infrared (CIR) stereo film positives. Before the workshop, 13 of 44 watersheds were identified as having problems with SAF cover type codes or discrepancies between SCS and office-determined watershed boundaries and wetland areas. These discrepancies were found by visually noting the presence or absence of SAF cover type codes on SCS overlays and by comparing SCS and office-determined landuse overlays with actual CIR photography for each watershed. Six kinds of reconciliation changes made were:

- leave lake or watershed delineations as per SCS overlays (1D1021, 1D1058, 1E1060, 1E2046)
- change existing SAF codes (1C2055, 1D1007, 1E1072),
- assign an SAF code to R (riparian wetland) polygons (1B1007, 1B3033, 1B3068),
- keep an R landuse code without an SAF cover type code (1E2004),
- match wetland shown on SCS drainage overlay with landuse on SCS landuse overlay (1B1038), and
- keep an SAF code without adding an R landuse (1B2048).

4 QUALITY ASSURANCE AND QUALITY CONTROL ACTIVITIES

PROGRESS FIELD REVIEWS

Progress field reviews were conducted according to the guidelines of the NCSS (SSS, 1983). A form, based on SCS form SCS-SOI-233, was developed to promote a uniform approach to items examined during reviews (Figure 4-1, Appendix A). The completed form was submitted to the Mapping Task Leader at ERL-C.

The mapping activities of each crew were evaluated and the following items were checked: adherence to protocols, base maps, map symbols, correspondence between soils and depth-to-bedrock mapping, documentation of soil taxonomic units, soil map units, pedon descriptions, general notes, soil transects, map delineation boundaries, and choice of map units. In addition, the reviewer conducted a randomly chosen traverse of the watershed to determine whether the mapping was correct.

Results of the Progress Field Reviews by the SCS State Staffs

The SCS State Soils Staffs involved in this project were responsible to conduct at least one field review of each mapping crew. Nine field reviews were conducted by the SCS State Soils Staffs of ME, NY, and PA which are listed in Table 4-1. No major problems were identified during the field reviews and no mapping was rejected by the reviewers. The choice between several similar map units, the size of delineations, and the addition of soil map units to the legend were most commonly discussed during the reviews. The opinion of the field personnel was that the field reviews were useful for clarifying aspects of the protocols. The reports of the reviews are evaluated by the RCC in Appendix D.

Results of the Progress Field Reviews by the RCC

The QA (Appendix C) specifies that the RCC should participate in one field review of a watershed for each State Soils Staff's region of responsibility which are listed in Table 4-2. The RCC did not participate in a field review of watersheds in PA for this survey because he participated in two field reviews for soil scientists working on mapping for the DDRP Mid-Appalachian survey, one of whom

Table 4-1 Field Reviews Conducted by the State Soils Staffs

Watershed ID	Watershed Name	State	Date
1A1019	Quiver Pond	NY	11/02/87
1A1037	Black Pond	NY	05/03/88
1B1006	Lake John	PA	05/06/88
1B2059	Mud Pond	PA	10/14-15/87
1B3013	Stump Pond	NY	10/14/87
1B3003	Triangle Lake	NY	04/07/88
1C3034	Hansen Pond	ME	07/26/88
1D2006	Ames Pond	ME	05/17-18/88
1E1097	Upper Oxhead Pond	ME	06/09/88

Table 4-2 Field Reviews Conducted by the RCC

Watershed ID	Watershed Name	State	Date
1A1037	Black Pond	NY	06/07/88
1E1097	Upper Oxhead Pond	ME	06/09/88

did a significant portion of the mapping for this survey. The RCC conducted two progress field reviews in conjunction with the SCS State Soils Staffs. They are discussed in more detail in the final report of the RCC included as Appendix D. Deficiencies noted during the reviews were the need for additional symbols denoting wet spots, the need for more notes to document differences from Official Series Descriptions, the need for transects to be conducted completely across a delineation, the need for more detail on some profile descriptions, the need to map in greater detail (some additional delineations needed to be drafted), and the inconsistent use of special symbols for short-steep-slopes. The RCC facilitated better communication among states to enhance the consistency of the mapping and improve correlation of the soil taxonomic and map units.

INDEPENDENT EVALUATION BY THE RCC

Procedures for Map Evaluation

The RCC independently evaluated 20 percent of the watersheds in the survey. The evaluations are discussed in more detail in Appendix D. Mapping was evaluated by examination of stereoscopic pairs of aerial photographs. Relationships between soils and landforms were scrutinized and areas were identified for closer examination by traversing and transecting.

Map correctness was judged by how well the map unit descriptions fit the soils in the mapped areas, and how accurately map unit boundaries were drafted on the maps. For this survey, the following mappable soil features were selected as most important:

- depth-to-bedrock or impermeable layer,
- drainage class,
- family particle-size class,
- slope, and
- rockiness class.

Consistent decisions about the acceptability of soil maps must be based on predetermined allowable differences. There are two measures of deviation from the expected values for soil maps that must be evaluated to determine if mapping is acceptable:

- the degree of variance from the expected value for each error, and
- the number of errors.

The degree of variance of the features selected as most important can be measured by class intervals. For example, if the reviewer expects the area to be mapped as well-drained, then a value of moderately well-drained varies from the expected by 1 class, whereas poorly drained varies from the expected by 3 classes. Acceptable mapping can be evaluated by use of the relationship between the number of errors and the degree of variation. Table 4-3 lists the number of errors for each 130 ha (320 acre) for mapping to be judged unacceptable. For example, a watershed with an area of 640

Table 4-3 **Map Acceptability Criteria**

Soil Characteristic	Number of Classes From Expected	Number of Errors* For Unacceptable Rating
Depth-to-bedrock or impermeable layer	1	5
	2	2
	3	1
Drainage Class	1	5
	2	2
	3	1
Particle-size class	1	8
	2	2
	3	1
Slope	1	8
	2	5
	3	1
Stoniness, boulderiness	1	10
	2	5
	3	2

* per 130 ha (320 acres)

acres must have less than 4 errors that differ from the expected particle-size class by 2 class intervals

standards were used as a guide to judge mapping acceptability at the discretion of the RCC.

Mapping Evaluation by the RCC

The watersheds evaluated by the RCC are listed in Table 4-4. The Mapping Task Leader selected the mapping units for transecting. The RCC evaluated 20 to 50 percent of the map delineations in the each of selected watersheds by traversing map delineations. The watershed boundary, soils map, and the landuse and forest cover map were evaluated. The depth-to-bedrock mapping was not evaluated separately because it is based on the soil mapping and the depth classes greater than two meters are difficult to field check unless there are numerous road cuts or artificial excavations.

Table 4-4 Independent Mapping Evaluations by the RCC

Watershed ID	Watershed Name	State	Date
1A2001	Twin Ponds (Eastern)	NY	07/13-14/88
1A2056	Huckleberry Lake	NY	07/06/88
1B1038	Goose Pond	PA	06/28-29/88
1B2069	Boyle Pond	PA	06/30/88
1B3003	Triangle Lake	NY	06/24/88
1C1046	Shaws Pond	NH	07/29-30/88
1D1011	No Name	MA	07/18-20/88
1D2087	Cusky Pond	MA	07/22-23/88
1E1060	Bracey Pond	ME	07/26-27/88

All nine watersheds evaluated by the RCC were judged to be of acceptable quality. Minor revisions were needed in 2 of the watersheds which affected 8 percent of a watershed and 37 percent of the other watershed. The major part of the latter change was changing the map units from complexes to consociations (defined in Appendix C) because the major soil comprised 70 percent of the consociation.

The remainder of the watersheds had only very minor discrepancies that the RCC deemed to be within the normal error of observation and did not require changes to the maps. These discrepancies involved only small areas. The minor items observed on the soil maps included soils that were taxadjuncts to series, areas that were stony or bouldery when appropriate map units describing this were not in the legend, incorrect slope designations, non-hydric soil delineations less than six acres, complexes that do not have the most abundant soil first in the name, consociations mapped that should have been complexes, and areas where 2 to 3 acres of hydric soils should have been delineated.

The RCC concluded that the landuse/forest cover type mapping was very well done. Problems with landuse mapping were caused by the lack of complete definitions of the classes. Problems encountered were with inappropriate classes for clear-cut areas, idle cropland, pasture overgrown with brush, brushy swampy areas, and hayland-pasture rotation. The discrepancies observed with forest cover mapping were minor and consisted of correctly identifying the major tree species but incorrectly identifying other trees such as red maple versus sugar maple.

EVALUATION OF SOIL TRANSECT DATA

Transect Data

Transects consisting of ten observations of the soil at equally spaced intervals across map unit delineations were conducted by field soil scientists and by the RCC during the independent map evaluations. The transects conducted by the field soil scientists, referred to as routine transects, were used in estimating the relative composition of components in the map units. There were 385 routine transects. Of the 179 map units in the survey, 24 (13 percent) had 3 or more transects, 37 (21 percent) had 2 transects, 73 (41 percent) had 1 transect, and 45 (25 percent) of the map units had no transect.

Transects conducted by the RCC were used to evaluate the correctness of map unit compositions that were estimated during the mapping and correlation and based in part on the routine transects. The RCC conducted transects in the watersheds that were selected for independent map evaluations. Map units selected for transecting by the RCC had been evaluated by at least three routine transects. The RCC conducted 61 transects in 18 different map units. Most of the map units had 4 transects for a total of 40 observations.

Analyses of Soil Transect Data

The RCC transect data were used to evaluate the correctness of the described map units. The routine transects do not provide an independent evaluation of the correctness of the compositions of soil components because the information from the routine transects was used in the soil correlation workshop to adjust the compositions of map unit components in the map unit composition database. However, the routine transects do provide a means to evaluate whether the delineations within the same map symbol are alike in composition of components.

The correctness of the map unit was evaluated by comparing the compositions of soils transected by the RCC with the expected compositions in the map unit composition database. Also, routine transects were compared to RCC transects. Finally, soil components observed at transect points were assigned to appropriate sampling classes, and map unit correctness was evaluated with respect to the sampling class composition. The latter evaluation was especially relevant in judging the correctness of map units for the purposes of DDRP. All hypothesis tests were conducted using two-sided alternative hypotheses.

Analysis of the Map Units by Major Components --

Major components were those comprising 20 percent or more of each map unit as determined from the map unit composition database. For the major components of each map unit, the transect points were treated as observations from a binomial distribution with the population proportion p, where p was calculated from the map unit composition database. The binomial distribution was used because the outcome of each transect can be classified in exactly 1 of 2 ways; either the proportion of a particular major map unit component matches the expected result from the map unit composition database or not. The sample proportion used was the total number of transect points with the same name as a major component, divided by the total number of transect points. If n, the number of transect points, was over 25 and the expected proportion p (i.e., the total composition of named components in the map unit, as estimated by the soil scientists and rounded to 5 percent increments) was not too close to zero or one, [i.e., $np > 5$ and $n(1-p) > 5$], then the normal approximation to the binomial was used. If 1 of these 3 conditions was not met, then the hypothesis test was computed directly from the binomial distribution.

A statistical analysis using only the binomial distribution can be produced from tables of the cumulative distribution function of the binomial. Assume that B(x) is the probability that a binomial with parameters n and p will be less than or equal to the constant x. Thus we can calculate B(x-1) [the probability of a lower value] and 1 - B(x) [the probability of a higher value] using x, the number of matching observations. If either of these values is less than half of the assumed level of significance, then the null hypothesis (that x comes from a binomial distribution with the specified p) is rejected.

For the 385 routine transects used in the analysis, hypothesis tests were performed at the 0.05 level of significance to locate transects that had compositions of major components that were significantly different from the expected compositions.

There were 11 transects that had compositions significantly different from the expected (Table 4-5). This was approximately three percent of all the transects in the dataset. Under the null hypothesis of no discrepancies, 5 percent, or roughly 19 transects, would be expected. This close agreement indicates that there is no statistical evidence that the delineations are unusually variable or dissimilar in composition of major components. Two of the map units in Table 4-5, 98B (Leicester) and 732A (Haplaquepts-Histic Humaquepts), turned out to have been transected on small delineations that had been correlated with the indicated map units. The map unit components were considered to be similar enough to correlate the map units, but the names of the components documented for the transect stops were different than those in the database.

Table 4-5 Significantly Different Map Unit Composition From Routine Transects for Major Components vs. Expected: by Individual Transect

MAP UNIT	WATERSHED	TRANSECT NUMBER	ROUTINE COMPOSITION	DATABASE * COMPOSITION	SIGNIFICANCE LEVEL
30A	1A2056	1	0.5	0.85	0.0197
54D	1E2046	2	0.5	0.85	0.0197
89D	1D2006	1	0.1	0.75	0.0000
98B	1D1007	1	0.0	0.75	0.0000
129B	1B2069	1	0.3	0.70	0.0212
178A	1B3068	1	0.5	0.90	0.0033
284B	1A3018	1	0.3	0.75	0.0070
359A	1E1060	1A	0.0	0.75	0.0000
382C	1E1017	2	0.6	0.90	0.0256
384B	1E1017	1	0.7	0.95	0.0115
732A	1C3034	1	0.0	0.65	0.0000

* Database composition is the expected composition from the map unit database

The variability in proportion of major components among transects was calculated. This was done to determine if some soils were highly variable in their compositions of major components. The variance of these compositions was calculated for each map unit with more than one transect. Since the distribution of these variances was asymmetric, a robust data analysis technique was used.

A boxplot of the variances of compositions was drawn. Boxplots use the interquartile range (IQR). This is the distance between the first and third quartiles which are the 25th and 75th percentiles respectively. Points more than 1.5 times the IQR away from the closest quartile are considered outliers, and points more than 3 times the IQR away from the closest quartile are considered strong outliers. The only map units that were more than 1.5 times the interquartile range above the 75th percentile were map units with one significantly different transect. This again suggests that the delineations are not noticeably dissimilar within map units.

Similarly, the RCC transects were examined for transects with significantly different compositions at the 0.05 level of significance (Table 4-6). There were 6 transects out of 61 that were found to have significantly different compositions. Under the null hypothesis, about three transects would have been expected. These 6 transects occur in 4 different map units. Each of these map units has other RCC transected delineations that were not significantly different from the expected compositions. This suggests that the problem lies with the individual transects rather than the map unit as a whole. These individual transects may not be representative of the delineations. These comparisons also suggest that the quality of the mapping examined by the routine transects was about as good as that performed by the RCC. Both had totals close to the expected number of transects under the null hypothesis.

The RCC transects were also examined for composition of major components in map units across all RCC transects. Significantly different transects were removed first, and 0.05 was used as the level of significance. Only one map unit was found to be significantly different than the expected composition (Table 4-7). The number of transects expected under the null hypothesis of no discrepancies is also one. No major problems with the estimated compositions of major components were observed.

Table 4-6 Significantly Different Map Unit Composition From RCC Transects for Major Components vs. Expected: by Individual Transect

MAP UNIT	WATERSHED	TRANSECT NUMBER	RCC COMPOSITION	DATABASE * COMPOSITION	SIGNIFICANCE LEVEL
129B	1B1-038	2	0.3	0.70	0.0212
141B	1B1-038	1	0.4	0.80	0.0127
141B	1B3-003	4	0.1	0.80	0.0000
192B	1A2-001	2	0.4	0.75	0.0395
192B	1E1-060	1	0.4	0.75	0.0395
214C	1A2-056	2	0.4	0.75	0.0395

* Database composition is the expected composition from the map unit database

Table 4-7 Significantly Different Map Unit Composition From RCC Transects for Major Components vs. Expected: by Map Unit

MAP UNIT	RCC COMPOSITION	DATABASE * COMPOSITION	SIGNIFICANCE LEVEL
236C	0.9	0.70	0.0168

* Database composition is the expected composition from the map unit database

Comparison of the Routine and RCC Transects --

Map unit composition calculated from the routine and RCC transects were compared for statistical differences. For these comparisons, the standard two-sample test for a difference in composition using the normal approximation was used whenever the previously mentioned criteria were met for both samples. When either sample was not appropriate for a normal approximation, Fisher's exact test was used.

Fisher's exact test (Fisher, 1935), is also known as the Fisher-Irwin test. This test assumes that a pair of binomial distributions with equal parameters, p, exist. The number of successes and failures from each sample can be arranged into a 2 x 2 table. The conditional distribution given the marginal totals is a hypergeometric distribution which is independent of the parameter p. The probability of a lower or a higher number of "yes" responses can be calculated from the hypergeometric distribution, and the null hypothesis of equal compositions can be rejected if either of these probabilities is too small (less than half of the level of significance).

The composition calculated from routine transects for two map units were found to have significantly different composition calculated from RCC transects as shown in Table 4-8. Both of these map units appeared to be significantly different because of a few extremely different transects. The routine proportion for map unit 22C is significantly higher than expected. The discrepancy for map unit 141B is due to two significant RCC transects, which appear in Table 4-6. After removing these two transects, map unit 141B is no longer significant. The expected number of significant map units under the null hypothesis is also one. This strong agreement suggests that the routine mapping produced results that were not noticeably different from that done by the RCC.

Table 4-8 Significantly Different Routine vs. RCC Transects by Map Unit

MAP UNIT	RCC COMPOSITION	RCC COUNT	ROUTINE COMPOSITION	ROUTINE COUNT	SIGNIFICANCE LEVEL
22C	0.800	30	0.940	50	0.0408
141B	0.379	29	0.800	50	0.0000

Analysis of the Map Units by Sampling Class --

The DDRP grouped together soils that were thought to have similar properties that influenced their response to acidic deposition in to sampling classes which are shown in Figure 4-1 (Lee et al., 1989b). Since there were to be several hypothesis tests for each map unit, the Bonferroni inequality was used to handle the error rate of the simultaneous hypothesis tests within each map unit. For a set of m simultaneous hypothasis tests on each map unit, we could assign an individual significance level equal to 0.05/m, so that the overall level of significance for the map unit would be at most 0.05. This was a conservative approach, but the simplest to program and implement. Also, significant individual transects were removed prior to the analysis.

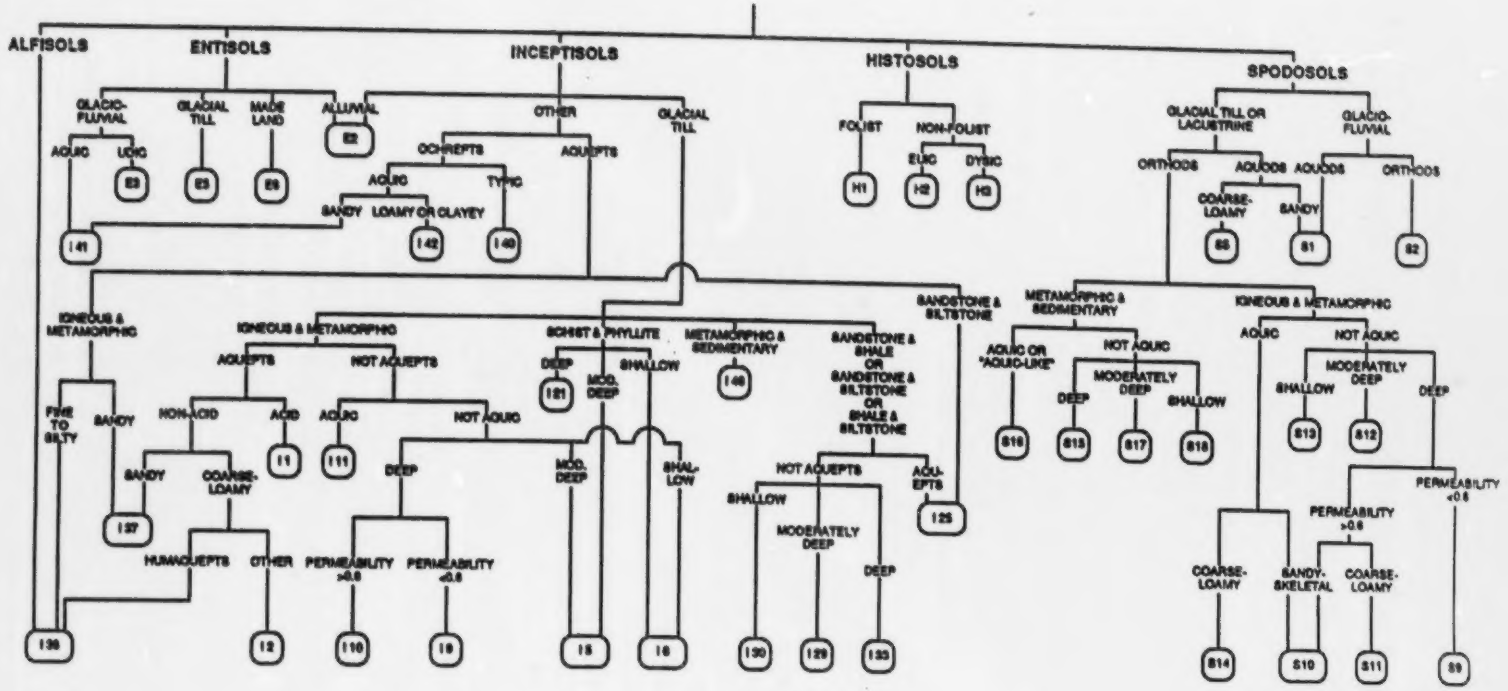
ALFISOLS
ENTISOLS
INCEPTISOLS
HISTOSOLS
SPODOSOLS
GLACIO-FLUVIAL
AQUIC
UDIC
E3
GLACIAL TILL
E5
MADE LAND
E6
ALLUVIAL
E2
OTHER
OCHREPTS
AQUIC
SANDY
LOAMY OR CLAYEY
TYPIC
AQUEPTS
GLACIAL TILL
I41
I42
I40
IGNEOUS & METAMORPHIC
FINE TO SILTY
SANDY
I37
IGNEOUS & METAMORPHIC
AQUEPTS
NON-ACID
SANDY
COARSE-LOAMY
HUMAQUEPTS
OTHER
ACID
I1
NOT AQUEPTS
AQUIC
I11
NOT AQUIC
DEEP
PERMEABILITY >0.6
PERMEABILITY <0.6
MOD. DEEP
SHAL-LOW
I36
I2
I10
I9
SCHIST & PHYLLITE
DEEP
I21
MOD. DEEP
SHALLOW
I5
I6
METAMORPHIC & SEDIMENTARY
I46
SANDSTONE & SHALE OR SANDSTONE & SILTSTONE OR SHALE & SILTSTONE
NOT AQUEPTS
SHALLOW
MODERATELY DEEP
DEEP
I30
I29
I33
AQU-EPTS
SANDSTONE & SILTSTONE
I25
FOLIST
H1
NON-FOLIST
EUIC
H2
DYSIC
H3
GLACIAL TILL OR LACUSTRINE
ORTHODS
AQUODS
COARSE-LOAMY
SANDY
S5
S1
GLACIO-FLUVIAL
AQUODS
ORTHODS
S2
METAMORPHIC & SEDIMENTARY
AQUIC OR "AQUIC-LIKE"
S16
NOT AQUIC
DEEP
MODERATELY DEEP
SHALLOW
S15
S17
S18
IGNEOUS & METAMORPHIC
AQUIC
COARSE-LOAMY
SANDY-SKELETAL
S14
S10
NOT AQUIC
SHALLOW
MODERATELY DEEP
DEEP
S13
S12
PERMEABILITY >0.6
COARSE-LOAMY
S11
PERMEABILITY <0.6
S9

Figure 4-1 DDRP Sampling Classes for the NE

After removing significant individual transects, the RCC transects were analyzed for significant sampling classes within map units. There was only one sampling class that differed significantly from the compositions estimated by the soil scientists (see Table 4-9). This sampling class represents a minor component in map unit 122D. At the 0.05 significance level we would actually expect about one map unit with significant sampling classes under the null hypothesis. This suggests that the sampling classes for the map units are not noticeably different from their expected compositions.

Table 4-9 Significantly Different Map Unit Composition for RCC vs. Expected by Sampling Class

MAP UNIT	SAMPLING CLASS	RCC COMPOSITION	EXPECTED COMPOSITION	NUMBER OF OBS.	SIGNIFICANCE LEVEL
122D	S09	0.20	0.05	30	0.0066

After removing significant individual transects, the routine transects were also analyzed for significant sampling classes within map units. Out of 174 map units analyzed, only three had significant sampling class compositions (Table 4-10). Under the null hypothesis, about eight or nine map units would be expected. This agreement suggests that the sampling classes for the map units are not noticeably different from their expected compositions.

Table 4-10 Significantly Different Transects for Routine vs. Expected by Sampling Class

MAP UNIT	SAMPLING CLASS	ROUTINE COMPOSITION	EXPECTED COMPOSITION	NUMBER OF OBS.	SIGNIFICANCE LEVEL
22C	S11	0.96	0.75	50	0.0006
46C	I05	0.55	0.35	40	0.0080
141D	I29	0.75	0.90	40	0.0101

Conclusions

The transect analyses suggest that there are no noticeable problems with the soil mapping. There were a few transects that suggest that they are in delineations that could have been mapped differently. No map units had unusually high variability, which might have indicated problems with the transecting or mapping. After the significant transects were removed, the map units were very consistent. The sampling classes matched the expected compositions well, indicating that there were few problems in the mapping as far as the DDRP project was concerned.

EXIT MEETING

An exit meeting was held to review mapping operations and to document how the mapping was done. Differences in interpretation of protocols by individuals and the need to make on-the-spot decisions during field operations has been recognized by project scientists. These activities may affect the quality of the mapping or the interpretations applied to the mapping data. A review of mapping operations pointed out some weaknesses in mapping protocols, training, and communication; and helped to evaluate mapping quality and reliability of assessment results. The review was conducted by soliciting responses to a questionnaire from SCS soil scientists representing the states responsible for the mapping, the Mapping Task Leader, and the RCC.

Recommendations From the Exit Meeting

The following is a summary of the recommendations made by the participants of the exit meeting:

- Training should be conducted for personnel just prior to beginning field work. Personnel conducting the mapping should have the goals and needs of the project fully explained to them to enable them to recognize properties that they should document and map.
- Changes to protocols should be kept to a minimum after mapping has started. Changes should be very carefully communicated to all field personnel. In ME this was a problem because the State Soil Scientist who was familiar with the protocols transferred to another state. Communication of changes was also a problem in NY because the mapping began as early as possible after which some of the protocols changed. This problem was compounded in NY because personnel who had been involved in the original DDRP NE mapping may not have closely read the revised protocols because they believed that they were already familiar with the protocols.

- Mapping crews should each map one watershed in its entirety, including drafting final map overlays, and then meet to discuss any questions or problems. Meeting would facilitate any changes or clarifications to the protocols and notify all the parties of any changes. Communication was not a problem in ME because both soil scientists worked together for a time.

- Topics discussed and decisions made during teleconference calls should be summarized and circulated to all of the mapping crews. This would ensure that all crews are working with the same understanding of the protocols. Some, but not all, of the teleconference calls were summarized by memos.

- The use of special symbols, such for wet spots and rock outcrops, on the soils maps should be standardized by explicit instructions in the protocols and discussion during training.

- The use of color-infrared and black-and-white aerial photography was very helpful but the orientation of the flightlines should be more strictly controlled. Photography with cloud-cover is not useful.

- Additional landuse codes should be developed. There should be more choices to describe open land other than pasture such as forbes, brushy land, clearcuts, and haylands, as well as land that is in rotation such as hayland-pasture, and haylands.

- The field review forms and reports should be sent to the RCC, as well as the Mapping Task Leader, within two weeks to allow the RCC to make a timely evaluation. In this survey, the RCC reviewed the field reviews after the mapping was complete which made the RCC evaluation less timely and useful.

- The DDRP QA Coordinator from ERL-C who used the field notes to help resolve map discrepancies recommended that a standard logbook should be developed to record the field notes. This would ensure that all of the watersheds are described in the same level of detail and that the same types of observations are recorded. Items that should be described include:

  - Amount of Human Activity including excavations, pits, roads, number of houses, camps, and agricultural activity.

  - Potential contamination such as septic tank or sewage contamination, application of chemicals to control algae or fungus in lakes, and heavy recreational use.

  - Watershed boundary information such as why watershed boundaries were changed from EPA supplied delineations and any special situations affecting watershed boundaries, such as diversion ditches.

  - Streams, evidence for classifying streams intermittent or perennial.

EVALUATION OF FINAL MAPS AND WRITTEN DOCUMENTATION BY SOIL SCIENTISTS

The final maps and written documentation were evaluated by ERL-C soil scientists before to digitization of the maps. Digitizing map data and correcting digitized data are time consuming tasks which make it critical that data be correct before digitizing takes place. Apparent discrepancies were resolved directly with the mappers and the SCS State Soils Staffs. Apparent discrepancies and situations requiring more information included watershed boundaries, depth-to-bedrock mapping compared to soils mapping, insufficient written documentation, missing symbols, stream placement, whether streams are intermittent or perennial, and potential water contamination. Discrepancies were resolved and the maps were digitized.

Watershed Boundaries

Correct watershed boundaries are very important because the characteristics within those boundaries are used to relate to the water chemistry sampled by the NSWS. Thus, the watershed boundary must include only the land area that contributes to surface flow of water to the stream above the sampling point of the NSWS. Mappers were provided with copies of topographic maps with watershed boundaries delineated by the NSWS based on the location of the water sampling point and the topography as inferred from the topographic map. Twenty-two departures from the NSWS boundaries are listed in Table 4-11 with the reason for the change. Table 4-11 reflects the changes that were a result of the ERL-C soil scientists' and the geographers' (described below) evaluations.

Wetlands are often on gentle relief and it may be hard to determine the direction of water flow with maps or aerial photographs. Streams may have changed their channels since topographic maps were made. Older topographic maps are often 15-minute quadrangles (1:64,000 scale) which may not be detailed enough for this study and may get distorted when enlarged to 1:24,000 scale. There were cases where water diversions, ditches, and construction had changed the direction of surface water flow from what the topographic maps or aerial photographs showed. There were instances where the soil scientists changed the NSWS watershed boundary because of complex microrelief caused by glacially deposited material in the form of hills or mounds (kames) and depressions (kettles).

Potential Contamination

Table 4-12 lists the watersheds that may have some potential contamination to water quality other than acidic precipitation. None of the watersheds were excluded from sampling because of the

Table 4-11 **Watershed Boundary Changes From NSWS Boundaries**

ID	Watershed	State	Comments
1A1019	Quiver Pond	NY	Major reduction in area when a marsh near the outlet was excluded.
1A1037	Black Pond	NY	NSWS boundary extended by mapper from field observation.
1A2001	Twin Ponds (Eastern)	NY	Slight problem with rectification. The NSWS may have used a different 15-minute topographic map.
1A2038	Cod Pond	NY	Wetland on west end drains out of watershed.
1A2056	Huckleberry Lake	NY	Topographic maps coverage of the watershed includes a 15-minute quadrangle which is wrong. Field checked by SCS.
1A3018	Sullivan Pond	NY	Topographic map in error. SCS reconfirmed boundary in field.
1B1007	Lopez Pond	PA	Extended the boundary to the northwest and delineated as lake what topographic map labels as wetlands.
1B2048	Wolf Swamp	PA	Extends further north and cuts out western portion. Mapper contacted.
1B3003	Triangle Lake	NY	Extends very slightly further north and northeast.
1B3068	Holp Pond	NY	Error in original NSWS boundary.
1C1046	Shaws Pond	NH	Base map was an enlarged 15-minute quadrangle which was not correct.
1C1069	Hidden Lake	VT	Northeast corner changed because road ditch intercepts surface flow.
1C3034	Hansen Pond	NH	Watershed made smaller because of kettle topography.
1D1007	Dean Pond	MA	Small changes made by SCS.
1D1011	No Name	MA	Major changes to boundary, all were carefully field checked. Beavers may have changed some of the drainage.
1D1021	Tippecansett Pond	RI	Several minor changes, a water diversion that affects five acres.

Continued

Table 4-11 **Watershed Boundary Changes From NSWS Boundaries (continued)**

ID	Watershed	State	Comments
1D1058	Griggs Pond	CT	Northeast corner changed because of cabin and site access construction.
1D2013	Benedict Pond	MA	Area added to watershed along east because of beaver activity.
1D3083	Lake Floren	CT	Watershed reduced because road ditch carries water below the outlet of lake.
1E1036	Crooked Brook Lake	ME	Minor changes made after field observation.
1E1060	Bracey Pond	ME	Area cut off the eastern edge because a kettle hole does not drain into the watershed.
1E2046	Rich Mill Pond	ME	Mappers found it to be significantly smaller than NSWS. Kame and kettles topography complicates watershed delineation.

Table 4-12 **Watersheds With Potential Contamination**

ID	Watershed	State	Comments
1B1038	Goose Pond	PA	The pond was once drained and a commercial peat operation was located here. The previous shoreline is one meter above present lake level.
1B2048	Wolf Swamp	PA	Some fields may have been limed. pH is greater than 6.9 in surface horizons.
1B3068	Holp Pond	NY	There were junk vehicles in head of small stream in northwest portion of watershed at edge of a field.
1C2055	North River Pond	NH	High density development is the principal source of pollution but extent of pollution is uncertain. There are a number of full time residents with septic systems around the pond and a sheep farm in the watershed.
1D1007	Dean Pond	MA	The lake may be eutrophic as evidenced by an algae bloom. There are trailers, a large dairy, and storm sewers for a small village in the watershed.
1D3004	Crocker Pond	MA	A heavily travelled highway dissects the watershed and may contribute pollutants such as road salt. Heavily used for swimming and picnics.
1D3083	Lake Floren	CT	Algae observed in shallow areas of the lake. Several seasonal camps and one new home within 25 m of shore may have an impact.
1E1036	Crooked Brook Lake	ME	A small area of asphalt highway cuts through the northwest corner of the watershed and may contribute a small amount of pollution such as road salt.
1E1072	Schoodic Lake	ME	Pesticides used for blueberry production on coarse textured soils. might leach into watertable.

potential contamination. While none of the pollution is thought to be significant, the watersheds have been identified to evaluate if they have anomalous properties from similar watersheds that do not have identified potential contamination.

Depth-to-Bedrock Mapping

The depth to bedrock mapping was easily checked because the classes were supposed to match the soil depth of the major soil of the map units. The depth-to-bedrock maps were overlaid on the soils maps for evaluation. The most common discrepancy was that multiple classes for soil complexes did not have the symbols listed in order of abundance. There were several instances where the soil scientist drafting the depth-to-bedrock map did not realize that it must match the soil map. It might have been better to have generated depth-to-bedrock maps at ERL-C based on the digitized soil maps and the soil depth from the mapping database rather than having the field soil scientists draft them.

Field Notes

The soil scientists were asked to record observations about soil and watershed characteristics in addition to profile descriptions and transect information. The notes were intended to give additional information concerning soil morphology, geomorphology, special landuse and cases where there was suspected contamination of soil or surface water. There was no standard format or specific guidelines for the content of the notes.

The notes were usually sketchy. They ranged in length from several sentences to two pages. The notes commonly discussed contamination, beaver activity, watershed boundaries, inclusions, and soil morphology. Charcoal in soil profiles that are evidence of past fires was noted in watersheds 1E1010, 1E1017, and 1E1072.

EVALUATION OF FINAL MAPS AND WRITTEN DOCUMENTATION BY GEOGRAPHERS

Final Map Analysis and Data Entry

A series of procedures, guidelines, and protocols were initiated to reduce the uncertainty of mapped data entered into a GIS. Central to this approach was the use of formalized log sheets to record the steps necessary to validate and digitize mapped data. The use of log sheets during the digitization process served several purposes. First, each technician was required to sign and date the log sheet following successful completion of each step to ensure consistency and accountability. Secondly, the signed log sheet became part of the permanent record of the project and, therefore, provided key documentation. Finally, because the log sheets identified a responsible party, it was possible to backtrack when systematic errors or problems were discovered. In addition to log sheets, accuracy and precision of the mapping products were formally evaluated at various stages. At critical stages, the evaluations were independently repeated by a second technician.

In addition to the SCS mapping products, the DDRP also obtained air photo information on land use/land cover, wetlands, and streams from the USEPA's Environmental Monitoring and Systems Laboratory - Las Vegas, NV (EMSL-LV). Although this document focuses on SCS mapping procedures and products, EMSL mapping was used during final map analysis and GIS data entry as an independent check on the accuracy and consistency of watershed mapping.

Pre-Digitization Procedures

Prior to data entry (digitization), the source maps were checked for consistency, accuracy, and completeness. The source maps were then adjusted or corrected prior to automation. Formalized log sheets were used to validate these procedures (Figure 4-2).

Watershed Delineation --

Watersheds were first delineated based on contour crenulations on 1:24,000 or 1:62,500 topographic maps. These maps with watershed boundaries were then sent to the SCS and EMSL-LV as a guide for locating the watersheds. During mapping, individual soil scientists mappers sometimes changed the predetermined topographic delineation based on ancillary evidence derived from air photos or field information which are documented in Table 4-11. These subjective changes

DDRP SOIL SURVEY
MAP CHECKING CHECKLIST
GEOGRAPHIC RESEARCH

Watershed ID________________ Watershed Name, County__________________________
State____________________
Name(s) of Reviewers____ Date___________
Mappers____
Date Mapped__________

1. Have all the map overlays arrived at ERL-C?
SCS
_____soils _____veg _____geo _____dep _____drainage _____transects

Photointerpretation
_____landuse _____detailed wetlands _____drainage

2. Are tic marks present and accurate?

DISCUSSION AND RECOMMENDED FOLLOWUP - Registration

3. Are SCS watershed delineations consistent?

4. Do SCS delineations follow NSWS delineations?

5. Do the photointerpreted delineations follow SCS and/or NSWS delineations?

DISCUSSION AND RECOMMENDED FOLLOWUP - Watershed delineations

6. Do SCS streams agree with USGS blue lines?

7. Do SCS delineations follow topographic features?

DISCUSSION AND RECOMMENDED FOLLOWUP - Drainage

Figure 4-2 Log Sheet for Geographers' Map Checking

were particularly evident in the low-lying areas of the Northeast and in areas that were only covered by older and less accurate 1:62,500 topographic maps.

There were potentially three different watershed boundaries: the preliminary NSWS estimate of the watershed delineation based on topographic maps, the field delineation, and the photo-interpreted delineation. First the field mapped boundary was checked against the topographic map boundary. Next, all delineations were compared for consistency (e.g., were the same ridgetops followed, was the outlet of the watershed consistently located, etc). If the field mapped boundary followed the topographic map and were consistent with each other, the watershed boundary was accepted. If there were large differences between the boundaries (e.g., watershed outlet not consistently located, inclusion or exclusion of sub-basins, etc.), it was assumed that the field mapped version to be correct as long as the SCS had a legitimate reason to adjust the boundary. Legitimacy was confirmed by discussing any "problem" areas with the soil scientists. The EMSL-LV maps were then adjusted or re-mapped to fit the final boundary. The watershed boundary changes are summarized in Table 4-11.

Watershed Consistency --

As described previously, all map layers were first checked for consistency in watershed perimeter and corrections were made. A second source of inconsistency was in the definition of water or lake boundaries. Errors within the SCS mapping layers were first identified, problem areas were discussed with SCS, and appropriate corrections made. Two inherent sources of variability, however, could result in different SCS versus EMSL-LV water body delineations. These sources included: (1) differences in mapping resolution of wetlands - EMSL-LV mappers delineated wetlands down to one acre while the SCS used a two acre minimum resolution, and (2) individual mappers produced different water body interpretations due to the limitations of the particular mapping technique (e.g., field versus photo-interpreted). Because of this inherent variability in the delineation of water bodies, absolute reconciliation between SCS and EMSL-LV lake delineations was not attempted.

Mapping Completeness --

All source maps were first visually scanned for completeness (e.g., existence of polygon codes) and obvious errors (e.g., missing line segments). Not much time was spent completing this task because these errors were more efficiently identified during subsequent QC procedures.

Mapping Registration --

Registration marks are used to transform digital maps to ground coordinates. Individual map layers were first checked for registration to a topographic map. Next, each individual layer was manually overlaid with other layers and consistency was examined and corrected where appropriate.

Map Unit Registration --

Map unit registration refers to how well the individual map units correlate with topographic and other physical features. To check map unit placement, the mapped information was compared with appropriate topographic maps. First, soils and depth-to-bedrock source maps were manually overlaid onto the topographic map. Next, the location of ridgetop soils were examined relative to topographic ridgetops and valley-bottom soils were examined relative to stream channels. If the mapped features followed the topographic features, map unit registration was accepted. The same general procedures were followed for vegetation as well, although these procedures relied on lowland, riparian, and open vegetation patterns and their correspondence with topographic features. If map unit registration was judged inadequate, the individual map layers (e.g., soils) were re-drawn to better fit topographic features.

Digitization Procedures

QC checks instituted during the digitization process addressed three major goals: digitization consistency, line segment accuracy, and attribute accuracy. As with pre-digitization procedures, the use of formalized log sheets was central to the approach.

Digitization Consistency --

Digitization consistency was ensured by using log sheets and by implementing specific technical guidelines for use in the digitization process. Formalized log sheets were used during both line segment digitization and attribute entry (Figures 4-3 and 4-4, respectively) to ensure consistent data entry, to provide key documentation, and to provide a system of accountability. Two technical guidelines were also used during the digitization process to increase consistency. First, a minimum acceptable Residual Mean Square (RMS) error was used during the transformation process. The RMS is the mean of the residuals squared of the tic registration versus the expected values (ESRI, 1987). In general, the minimum acceptable RMS error was 0.003, although higher RMS values were occasionally accepted when using poor quality source maps. Second, a template layer containing the watershed and water body boundaries was digitized using the soils layer as a guide. Line segments and attributes were then added to the template coverage for each of the individual layers. This helped to ensure consistent watershed and water body boundaries for all layers.

Line Segment Digitization --

The steps used in line segment digitization are depicted in Figure 4-2. During digitizing, all line segments were purposely extended as overshoots to create "dangling chains" (Chrisman, 1987). The overshoots were then automatically deleted during the building of topological structure. Following digitization, plots were made using an internal editing feature of the ARC/INFO software. These plots depicted polygon errors including: unclosed polygons, unlabeled polygons, or polygons with more than one label point. Identified errors were corrected before continuing. A new plot displaying all digitized line segments and labels was then made at the same scale as the manuscript maps. The plot was overlaid with the manuscript maps onto a light table. If any light showed through between the digitized line segment and the drafted line, the line segment was corrected and the polygon error check was repeated.

DIRECT/DELAYED RESPONSE PROJECT - COVERAGE AUTOMATION LOG

WATERSHED NO.________ DATE_______

INITIALIZE UPON COMPLETION

1. $ SET DEF [DDELAY.-----]

2. $ ARC

3. ARC: ADS LANDDG — LANDDG_________
   digitize tics, watershed boundary,
   all water bodies, and all landuse polygons.

4. ARC: CLEAN LANDDG LANDCN .25 — LANDCN_________

5. ARC: EDITPLOT LANDCN LAND.PLT — LAND.PLT_______
   Check for polygon errors

6. ARC: ARCEDIT — LANDCN_________
   Make corrections, as needed.
   Repeat steps 4-6, as needed

7. ARC: COPY LANDCN LANDUSE — LANDUSE________

Figure 4-3 Coverage Automation Log

DIRECT/DELAYED RESPONSE PROJECT - DATA ENTRY LOG

WATERSHED NO.________ DATE_______

INITIALIZE UPON
COMPLETION

```
1.    $ SET DEF [DDELAY.-----]


2.    $ COPY [DDELAY]BASE.DAT LAND.DAT


3.    $ VP LAND.DAT
            type in data                                      LAND.DAT_______
            <ctr>z


4.    $ ARC


5.    ARC: INFO
      USER NAME> ARC
      ENTER COMMAND> ADIR [DDELAY.SKELETON1.INFO]             LANDTAB________
      ENTER COMMAND> TAKE ARC *
      ENTER COMMAND> SEL LANDTAB
      ENTER COMMAND> ADD FROM [DDELAY.----]LAND.DAT
      ENTER COMMAND> LI - check data
      ENTER COMMAND> Q stop


6.    JOINITEM LANDUSE.PAT LANDTAB LANDUSE.PAT LANDUSE-ID LANDUSE-ID

                                                              LANDUSE.PAT____
7.    ARC: INFO
      USER NAME> ARC
      ENTER COMMAND> SEL LANDUSE.PAT
      ENTER COMMAND> LI - check .PAT file
      ENTER COMMAND> Q STOP
```

Figure 4-4 Data Entry Log

Attribute Entry --

The steps used in attribute entry are shown in Figure 4-3. First, the attributes for each map unit were entered into an text file and visually scanned for obvious errors. Corrections were then made before proceeding to the next step. The text file containing the attributes was loaded into an GIS database "template" file containing the appropriate item definitions. The template file was merged with the coverage, visually scanned for any obvious errors, and corrected where appropriate. A more thorough evaluation of attribute accuracy was performed following digitization.

Post-Digitization Procedures

Post-digitization QC procedures included checks on coverage accuracy and ground coordinate registration. Coverage accuracy was evaluated through two independent checks of edit plots and by examining the regional consistency and validity of attribute codes. Projection accuracy checks included comparisons within the original data and comparisons between the digitized data and other independent data.

Coverage Accuracy --

Final plots depicting line segments and attributes of each coverage were first generated. These plots were then compared with the original source maps over a light table and checked for accuracy. If any light passed between the digitized line segment and the drafted line, the digitized line segment was corrected to match the drafted line segment, and the necessary QC procedures were repeated. If the line segments were judged to be correct, each individual coverage attribute was then checked against the source map for accuracy and corrected as needed. This entire procedure was performed independently by two individuals. If the coverage was judged to be correct, the individuals were required to sign the plot indicating acceptance. As a final check, attributes for all watersheds were written to a computer file, sorted, and independently checked for consistency and validity. This final sorting and checking of the master file helped to identify non-obvious errors such as substitution of the letter "O" with the number "0".

Projection Accuracy --

A series of procedures was used to accurately transform the coverages into ground coordinates, including comparing: (1) "projected" coverages with source map (2) EMSL-LV land use and SCS projections, and (3) digitized mapped data with independently obtained data.

First, the coverages were converted into universal transfer Mercator (UTM) coordinates. The projected coverages were then overlaid with the source map and checked for registration and reasonableness of fit. The position of projected watersheds were then compared with coordinates of the appropriate lake as documented by the NSWS. The NSWS point location data represented the lake locations estimated independently from 1:24,000 or 1:62,500 topographic maps. To detect locational errors or any major differences in watershed or lake delineations, the SCS base coverage was then visually compared to the EMSL-LV coverage. Finally, watershed area was calculated and compared for the SCS versus EMSL-LV land use coverages. Watersheds with variations of greater than five percent were flagged and visually re-examined.

5 CONCLUSIONS

CONCLUSIONS FROM THE SCS FIELD REVIEWS

The overall quality of the mapping was found to be acceptable. Only minor deficiencies were identified and were subsequently corrected. The reviews provided opportunities to examine and discuss potential additions to the soils legend. Often the choices between relatively similar map units were discussed during the reviews. The choice between map units to label a delineation is not always clear. Soils are a continuum between established series and map units which can make the selection of map units difficult.

Problems with the minimum size of delineations included drafting delineations of less than six acres for soils that were not hydric or formed in alluvium and, conversely, not drafting appropriate delineations of hydric soils and soils formed in alluvium that were less than six acres but greater than two. In a few instances, the boundaries drawn between map delineations did not follow landscape patterns. Correct interpretation of landforms is essential to drafting appropriate map delineation boundaries because map units are differentiated by slope classes, drainage, depth, and/or parent material which nearly always follow landscape patterns.

CONCLUSIONS FROM THE RCC FIELD REVIEWS

The RCC concluded that the mapping in the two watersheds where he conducted field reviews was of acceptable quality with only minor corrective actions. It was recommended that the mappers use more conventional symbols for short-steep-slopes, that some delineations of less than six acres of forest cover types be deleted, that more detailed notes be taken, and that more information about reaction and consistence was needed in soil profile descriptions to adequately classify some soils. More information about the RCC field reviews is presented in Appendix D.

The RCC reviewed the SCS field review reports and concluded that the reviews had been complete and gave a good indication of the progress of the mapping crews. The reports did not adequately document the percentage of map units that were checked in the field. The RCC concluded that it would have been best for the RCC to have reviewed the SCS field review forms and reports earlier in the project, rather than after all the field work was complete.

CONCLUSIONS FROM THE RCC INDEPENDENT EVALUATION

The nine watersheds evaluated by the RCC were all of acceptable quality. Minor revisions were needed in two of the watersheds which affected 8 percent of one watershed and 37 percent of another. The major part of the latter change was changing the map units from complexes to consociations because the major soil comprised 70 percent of the consociation.

The remainder of the watersheds had only very minor discrepancies that the RCC deemed to be within the normal error of observation and did not require changes to the maps. These discrepancies involved only small areas. The RCC concluded that the landuse/forest cover type mapping was very well done. Problems with landuse mapping were caused by the lack of complete definitions of the classes. The discrepancies observed with forest cover mapping were minor. They consisted of correctly identifying the major tree species but incorrectly identifying trees such as red maple versus sugar maple.

CONCLUSIONS FROM THE ANALYSES OF TRANSECT DATA

RCC Evaluation of Transects

The evaluation of transect data by the RCC gives some insight how to evaluate all of the transect data. The RCC determined that 69 percent of the transects that he conducted were acceptable matches to the named map unit. It was found that 18 percent did not exactly match the named unit but were the best units to map given constraints of the soil map legend. There were 13 percent that were not acceptable matches for the named map unit. Of the 13 percent, only 1 delineation with 1 transect (1.6 percent of the total) may have been incorrectly mapped if one considers DDRP sampling classes rather than map units.

The RCC concluded that when there were only one or two transects for a map unit, there was not a large enough sample size to estimate the composition of the map unit. A single transect in a small delineation might sufficiently describe the map unit composition, however in large delineations a single transect may give an incorrect map unit composition.

Statistical Evaluation of the Transects

The transect analyses suggest that there are no measurable problems with the soil mapping. There were a few transects that indicated the delineations could have been mapped differently. No map units had unusually high variability, which might have indicated problems with the transecting or mapping. After a few significantly different transects were removed, the map units were very consistent. The sampling classes matched the expected compositions well, indicating that there were few problems in the mapping as far as the use by the DDRP project was concerned.

OVERALL CONCLUSIONS

The mapping was found to be of acceptable quality for the intended use. The completeness goal of mapping 100 percent of the preselected watersheds was achieved. The goal for completeness of field documentation was achieved, but the amount and detail of field notes varied greatly. The SCS State Soil Staffs' field reviews and map evaluations found no significant problems with the mapping. The RCC's overall conclusion was that the mappers did a very thorough and careful job and that, based on 20 percent of the watersheds, the mapping meets the requirements of the DDRP protocols. Statistical analyses of the transect data did not suggest any problem with the mapping and map unit composition estimates.

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APPENDIX A:

DIRECT/DELAYED RESPONSE PROJECT: MAPPING PROTOCOLS FOR ADDITIONAL MAPPING IN THE NORTHEASTERN REGION OF THE UNITED STATES

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LIST OF ABBREVIATIONS AND SYMBOLS

DDRP -- Direct/Delayed Response Project
USEPA -- Environmental Protection Agency
ERL-C -- Environmental Research Laboratory-Corvallis
NCSS -- National Cooperative Soil Survey
QA/QC -- Quality Assurance/Quality Control
RCC -- Regional Coordinator/Correlator
SAF -- Society of American Foresters
SCS -- Soil Conservation Service
USGS -- US Geological Survey

1 INTRODUCTION

The mapping protocols are developed to guide personnel involved in the mapping of watersheds selected for study under the Direct/ Delayed Response Project (DDRP). These protocols are directed toward journeyman soil scientists experienced in soil mapping, soil classification, and the natural relationships among soils and landforms. In general, the mapping protocols used by the DDRP follow standard procedures used by the National Cooperative Soil Survey (NCSS) with minor modifications. Readers may refer to the National Soils Handbook (Soil Survey Staff, 1983) and Soil Taxonomy (Soil Survey Staff, 1975) for in-depth understanding of soil mapping principles, detailed descriptions of soil survey procedures and definition of special terminology used in these protocols.

The mapping protocols describe detailed procedures used in the additional activities of the DDRP in the Northeast Region of the United States mapping. The objective is to describe the following:

- the development and control of uniform map unit descriptions and mapping legends,
- the end products of mapping, and
- quality assurance/quality control (QA/QC) for mapping.

The protocols presented in sections 2 through 4 are specific to the DDRP, and are modifications of the procedures used by NCSS.

2 DESCRIPTIVE LEGEND

The descriptive legend is the basic document that governs the conduct of the soil survey and is composed of three parts: descriptions and classification of the soil taxonomic units, identification legend, and conventional and special symbols legend. One descriptive legend describes the soils throughout the region.

DESCRIPTION AND CLASSIFICATION OF THE SOILS

Description and classification of the soils consist of descriptions of taxonomic units (components of map units) as they occur in the survey area. Soil descriptions are referenced to official soil series descriptions with appropriate range in soil characteristics as the soil occurs in the survey area.

Selected characteristics of the soil taxonomic units are recorded in tabular format and entered into a computer database. These characteristics of the components (taxonomic units) of each map unit are also to be listed on the Soil Map Unit Worksheet (Figure 2-1).

Listed below are the characteristics used to describe soil taxonomic units for this project:

- name: series, surface texture phase, slope phase, other phase(s),
- parent Material: mode of deposition, origin,
- depth to bedrock,
- depth to slowly permeable or impermeable layer,
- drainage class,
- permeability,
- hydrologic group, and
- taxonomic classification.

Taxonomic unit descriptions are supported by field note soil descriptions and transect notes. Two field note soil descriptions for each soil (series, etc.) are recorded on a soil pedon description

MAP SYMBOL/MAP UNIT NAME
215C/TUNBRIDGE-LYMAN COMPLEX   8-15% SLOPES VERY ROCKY

REGIONAL LANDFORM	LOCAL LANDFORM
GLACIATED UPLANDS	HILLSIDE or MTNSIDE

GEOMORPHIC POSITION	SLOPE SHAPE ACROSS	SLOPE SHAPE DOWN
SUMMIT CRESTED HILLS	COMPLEX	COMPLEX

	COMP%	COMPONENTS	TEXTURE	SLOPE	SMPL CLASS	SCODE
1.	35	LYMAN	FSL	8-15%	S13	119
2.	35	TUNBRIDGE	FSL	3-15%	S12	245
3.	10	RICKER	PEAT	8-15%	H01	B 77
4.	5	ABRAM	FSL	8-15%	E05	D 43
5.	5	ROCK OUTCROP			M01	349
6.	5	SKERRY	FSL	3-8%	S14	223
7.	5	BERKSHIRE	FSL	8-15%	S11	27

	PARENT MATERIAL MODE OF DEPOSITION	PARENT MATERIAL ORIGIN
1.	GLACIAL TILL	MXD-IGNS & MTAMORPHC
2.	GLACIAL TILL	MXD-IGNS & MTAMORPHC
3.	ORGANIC	ORGANIC
4.	GLACIAL TILL	MXD-IGNS & MTAMORPHC
5.		
6.	GLACIAL TILL	MXD-IGNS & MTAMORPHC
7.	GLACIAL TILL	MXD-IGNS & MTAMORPHC

	DEPTH TO BEDROCK (CM)	DEPTH TO IMPERMEABLE LAYER (CM)
1.	25	43
2.	50	71
3.	10	23
4.	10	13
5.	0	0
6.	150	64
7.	150	150

	PERMEABILITY	DRAINAGE	HYDROLOGIC GROUP
1.		SOMEWHAT EXCESSIVE	D
2.		WELL	B
3.		SOMEWHAT EXCESSIVE	C
4.		EXCESSIVE	D
5.			D
6.		MODERATELY WELL	C
7.		WELL	B

	SUBGROUP	PARTICLE SIZE	MINERALOGY
1.	LITHIC HAPLORTHODS	LOAMY	MIXED
2.	TYPIC HAPLORTHODS	COARSE-LOAMY	MIXED
3.	LITHIC BOROFOLISTS		
4.	LITHIC UDORTHENTS	LOAMY	MIXED
5.			
6.	AQUIC HAPLORTHODS	COARSE-LOAMY	MIXED
7.	TYPIC HAPLORTHODS	COARSE-LOAMY	MIXED

	REACTION	TEMPERATURE REGIME	OTHER
1.		FRIGID	
2.		FRIGID	
3.		FRIGID	
4.		FRIGID	
5.			
6.		FRIGID	
7.		FRIGID	

Figure 2-1 Soil Map Unit Worksheet (example)

form (Figure 2-2) or soil transect data form (Figure 2-3). Taxonomic unit descriptions made during transecting may be recorded on the soil transect data form if there is enough space to legibly record important characteristics. The official soil series description will be used as the reference or representative soil description for series taxonomic units. Taxonomic units other than series will be represented by one of the two field soil descriptions.

IDENTIFICATION LEGEND

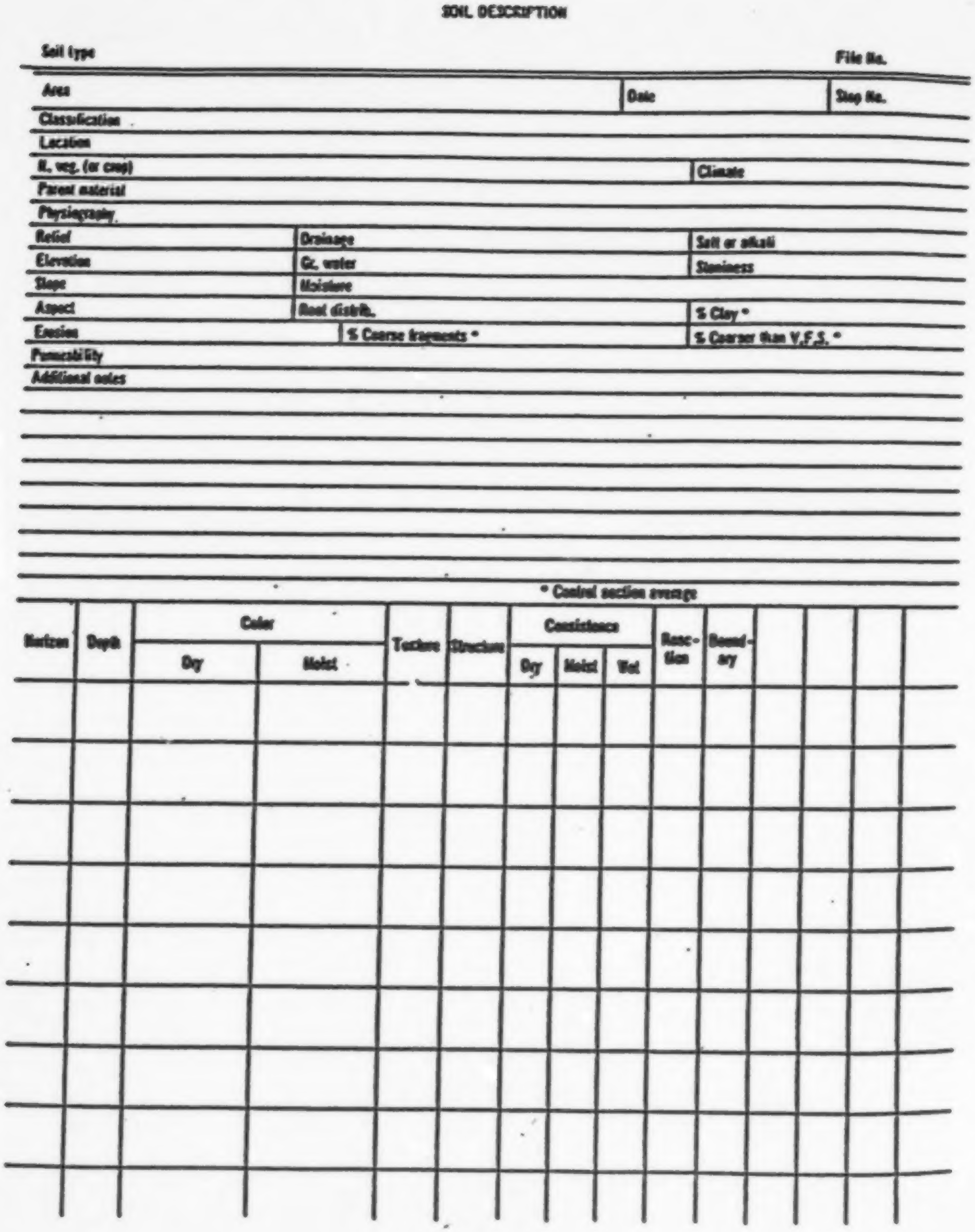
The identification legend consists of the name of the soil survey area and the date that the legend was prepared, a list of symbols to identify soil map units and names of soil map units. The identification legend is entered into a data management file at the USEPA's Environmental Research Laboratory, Corvallis, Oregon (ERL-C). Changes or additions to the legend are submitted through the Soil Conservation Service (SCS) State Soil Scientist and Regional Coordinator/Correlator (RCC) to the Mapping Task Leader at ERL-C.

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

A conventional and special symbols legend consists of a list of conventional symbols used to identify manmade works and structures, boundaries and drainage; and a list of special symbols to identify areas of soil, special features or kinds of miscellaneous areas that are too small to be delineated at the scale of mapping. The Conventional and Special Symbols Legend Form (SCS-SOI-37A) will be used to prepare the conventional and special symbols legend.

SOIL MAP UNITS

Soil map units are designed and delineated to relate soil patterns to naturally occurring landscape elements or segments. Soil mapping is based on enough observations to determine soil/landscape relationships and to confirm predictions of soil occurrence established from these relationships. The scientific basis for mapping is that soils and their location on the landscape are predictable to an experienced soil scientist with a knowledge of the geology, vegetation, climate, and landform patterns of the area.



SOIL DESCRIPTION

Soil type File No.

Area | Date | Stop No.

Classification

Location

N. veg. (or crop) | Climate

Parent material

Physiography

Relief | Drainage | Salt or alkali

Elevation | Gr. water | Stoniness

Slope | Moisture

Aspect | Root distrib. | % Clay *

Erosion | % Coarse fragments * | % Coarser than V.F.S. *

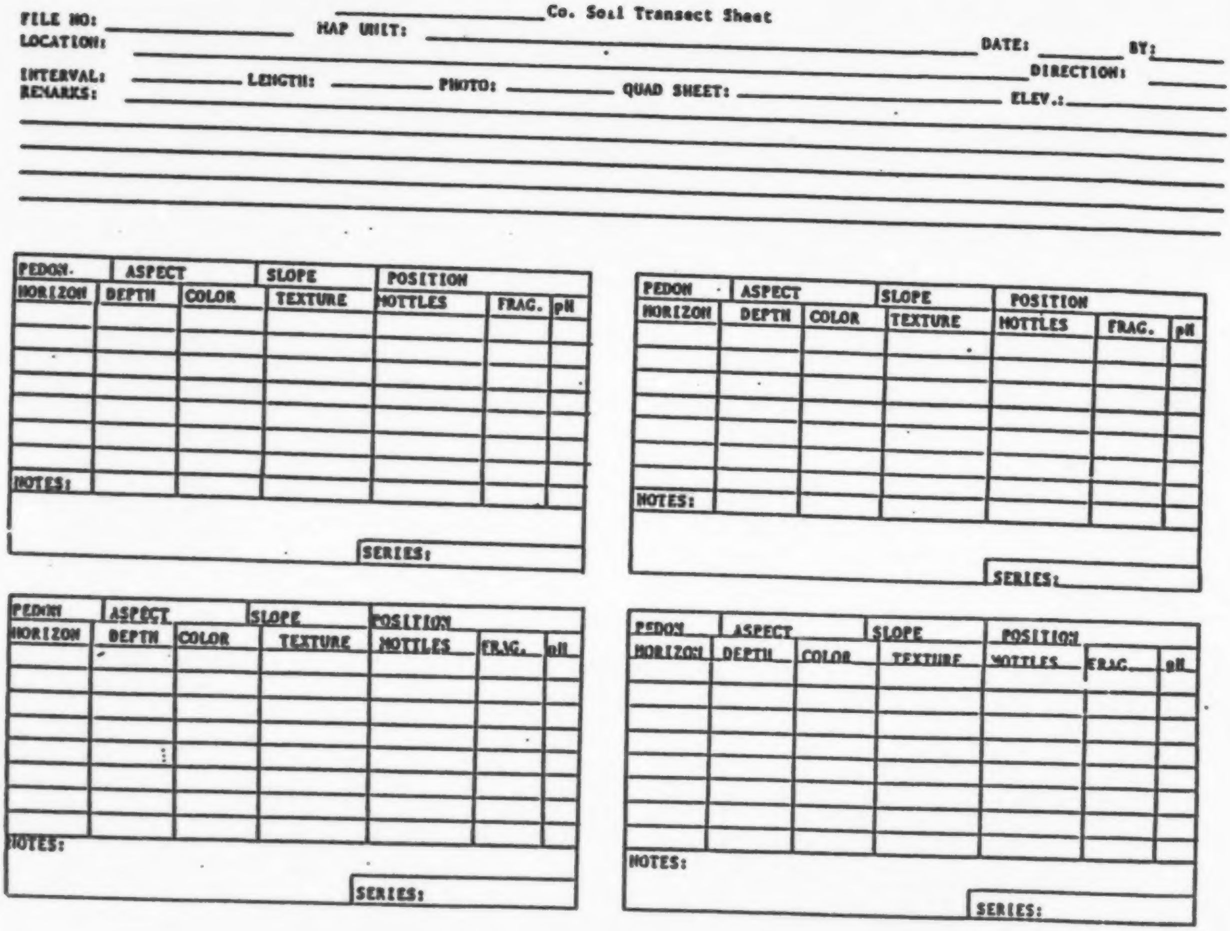
Permeability

Additional notes

* Control section average

Horizon	Depth	Color		Texture	Structure	Consistence			Reaction	Boundary				
		Dry	Moist			Dry	Moist	Wet						

Figure 2-2 Soil Description Form



__________ Co. Soil Transect Sheet

FILE NO: __________ MAP UNIT: __________

LOCATION: __________ DATE: __________ BY: __________

INTERVAL: __________ LENGTH: __________ PHOTO: __________ QUAD SHEET: __________ DIRECTION: __________

REMARKS: __________ ELEV.: __________

PEDON	ASPECT		SLOPE	POSITION		
HORIZON	DEPTH	COLOR	TEXTURE	MOTTLES	FRAG.	pH

NOTES:

SERIES:

PEDON	ASPECT		SLOPE	POSITION		
HORIZON	DEPTH	COLOR	TEXTURE	MOTTLES	FRAG.	pH

NOTES:

SERIES:

PEDON	ASPECT		SLOPE	POSITION		
HORIZON	DEPTH	COLOR	TEXTURE	MOTTLES	FRAG.	pH

NOTES:

SERIES:

PEDON	ASPECT		SLOPE	POSITION		
HORIZON	DEPTH	COLOR	TEXTURE	MOTTLES	FRAG.	pH

NOTES:

SERIES:

Figure 2-3 Soil Transect Data Sheet

Map units for the survey are mostly consociations and complexes with occasional undifferentiated groups. Map units are named for the major component(s) of the unit. Components of map units are mostly phases of soil series or miscellaneous areas; map unit components named at a categorical level above series may also be used. The range in characteristics of one soil component should not be so great to include strongly contrasting soils.

Characteristics of each map unit will be described and recorded in tabular format on the Soil Map Unit Worksheet (Figure 2-1). The following information will be recorded:

- map symbol,
- name of map unit,
- dominant landform: regional, local,
- geomorphic position in landscape,
- slope configuration: across, down,
- soil components: extent (%), name, and
- additional notes.

The extent of major map unit components and inclusions (soils or miscellaneous areas) will be estimated from landscape relationships, aerial photograph interpretation and field observations. Transect observations will help to determine the composition of a map unit, but will not always provide the most accurate estimate.

3 END PRODUCTS OF MAPPING

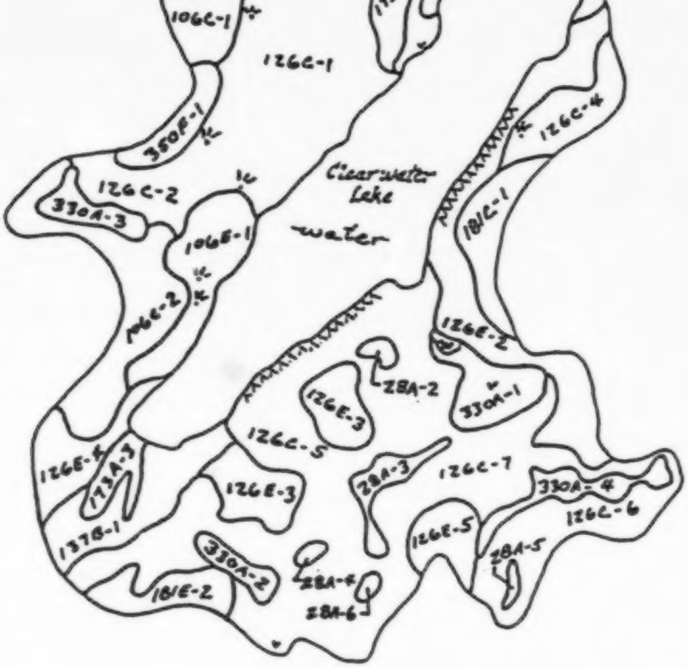
Landscape attributes will be inventoried in watersheds selected for the project. Watershed boundaries will be interpreted from topographic quadrangle maps and with stereoscopic study of aerial photographs to verify that the boundary delineates the area that drains to the downstream sample point or lake. Segments of the watershed boundary that are uncertain will be field checked.

Products delivered from watershed mapping activities include:

- Soil maps at 1:24,000 scale on mylar overlays of US Geological Survey (USGS) topographic quadrangles with contrasting kinds of soils to a minimum delineation of 2 to 6 acres (2 acres on hydric or soils formed in alluvium).
- Soil transect maps on mylar overlay at 1:24,000 scale.
- Estimated depth to bedrock maps on mylar overlays at 1:24,000 scale using six specified depth classes to a minimum delineation of 2 to 6 acres (2 acres on hydric or soils formed in alluvium).
- Landuse/forest cover maps on mylar overlays at 1:24,000 scale to a minimum delineation of 2 to 6 acres (2 acres on hydric or soils formed in alluvium).
- Maps of watershed drainage system and other water features on a mylar overlay of a topographic quadrangle map at 1:24,000 scale.
- Identification legend, conventional and special symbols legend.
- Descriptions of the map units recorded in tabular format on map unit worksheets; supported by a minimum of one field note for each map unit on each watershed.
- Descriptions of the soils; a minimum of two soil pedon descriptions (field note) for each kind of soil (series) mapped and a copy of the Official Soil Series Description with the range in characteristics adjusted to reflect the soil as mapped in the region.
- Transect data, one randomly selected, 10-point transect of each different map unit on a watershed (all map units if 10 or less plus 1/2 of the number of different map units greater than 10).

SOIL MAPS

Soil maps are drafted on mylar overlays (Figure 3-1) registered to a 1:24,000 scale topographic quadrangle or orthophotoquad base map. Minimum size delineation of soil map units is 2 to 6 acres.


181E-1
173A-1
28A-1
173A-2
126C-3
137C-1
106C-1
126C-1
350F-1
126C-4
126C-2
330A-3
Clearwater Lake
water
106E-1
181C-1
106E-2
126E-2
28A-2
126E-3
330A-1
126C-5
126E-4
173A-3
126E-3
28A-3
126C-7
330A-4
126C-6
137B-1
330A-2
181E-2
28A-4
28A-6
126E-5
28A-5

SOILS OVERLAY

CLEARWATER LAKE
1K029043

LEGEND

MAP UNIT SYMBOL	MAP UNIT NAME	ACRES	AVAILABLE TRANSECTS
* 28A	BIDDEFORD MUCKY PEAT, 0-3% SLOPES	41.4	1,2,③,4,5,6
* 106C	LYMAN-ROCK OUTCROP-TUNBRIDGE COMPLEX, 3-15% SLOPES	82.9	1,②
106E	LYMAN-ROCK OUTCROP-TUNBRIDGE COMPLEX, 15-45% SLOPES	28.7	1,
* 126C	MONSON-ROCK OUTCROP-ELLIOTTSVILLE COMPLEX, 3-15% SLOPES	350.7	①2,3,4,5,6,7
* 126E	MONSON-ROCK OUTCROP-ELLIOTTSVILLE COMPLEX, 15-45% SLOPES	89.2	1,②,3,4,5
* 137B	NICHOLVILLE SILT LOAM, 3-8% SLOPES	28.7	①
* 137C	NICHOLVILLE SILT LOAM, 8-15% SLOPES	22.3	①
* 173A	ROUNDABOUT SILT LOAM, 0-3% SLOPES	28.7	1,②,3
* 181C	ABRAM-ROCK OUTCROP COMPLEX, 3-15% SLOPES	19.1	①
* 181E	ABRAM-ROCK OUTCROP COMPLEX, 15-45% SLOPES	22.3	1,②
* 330A	BUCKSPORT MUCK, 0-3% SLOPES	51.0	①2,3,4
* 350F	ROCK OUTCROP	12.7	①
W	WATER	237.1	
	TOTAL	1014.8	

Figure 3-1 Soil Map (example)

Inclusions may be greater than 6 acres if the differences are slight and if there is no readily observable landscape feature to use for delineation. Only hydric soils and soils formed in alluvium should be delineated at less than 6 acres.

The soils in each delineation are identified by transecting, traversing, and field investigation of each delineation. Soil map unit boundaries are drawn from observation and interpretation of aerial photographs, follow landscape features, and are verified by field observations. More specifically:

- The most current readily available aerial photographs are used.
- Map units conform to topographic and landscape features and photo imagery.
- All map delineations are traversed or visited in the field. If soils in the watershed have previously been mapped the information may be used, but the watershed should be visited and remapped at 1:24,000 scale using the soil survey legend developed for the DDRP.
- Acres of each map unit are measured and tallied by watershed.
- Field notes are systematically recorded for all watersheds.
- Use Special Symbols for Soil Survey as shown in the Conventional and Special Symbols Legend, SCS-SOI-37A.
- Anything unusual about the watershed, including any access or potential sampling problems, is documented in the field notes.
- Any subjective decisions (i.e., decisions not based on pre-existing criteria), including logic and rationale are documented in the additional notes section of the field notes.
- The map unit symbol, name of the map unit and total acres of each map unit are recorded in a soil legend on the soil map of each watershed.
- An available transect is identified for each delineation on the soil map by numbering consecutively for each kind of map unit. The number is followed by a dash after the map symbol (eg. 126C-1, 126C-2, 126C-3). Available transects will be listed with the soil legend for each watershed, and selected transect numbers will be circled.

SOIL TRANSECT OVERLAY

Actual soil transects, which are randomly selected for field documentation, are marked on a soil transect overlay (Figure 3-2) at a map scale of 1:24,000. The transect location will be indicated with a line and an arrow shows the direction in which the transect was run.

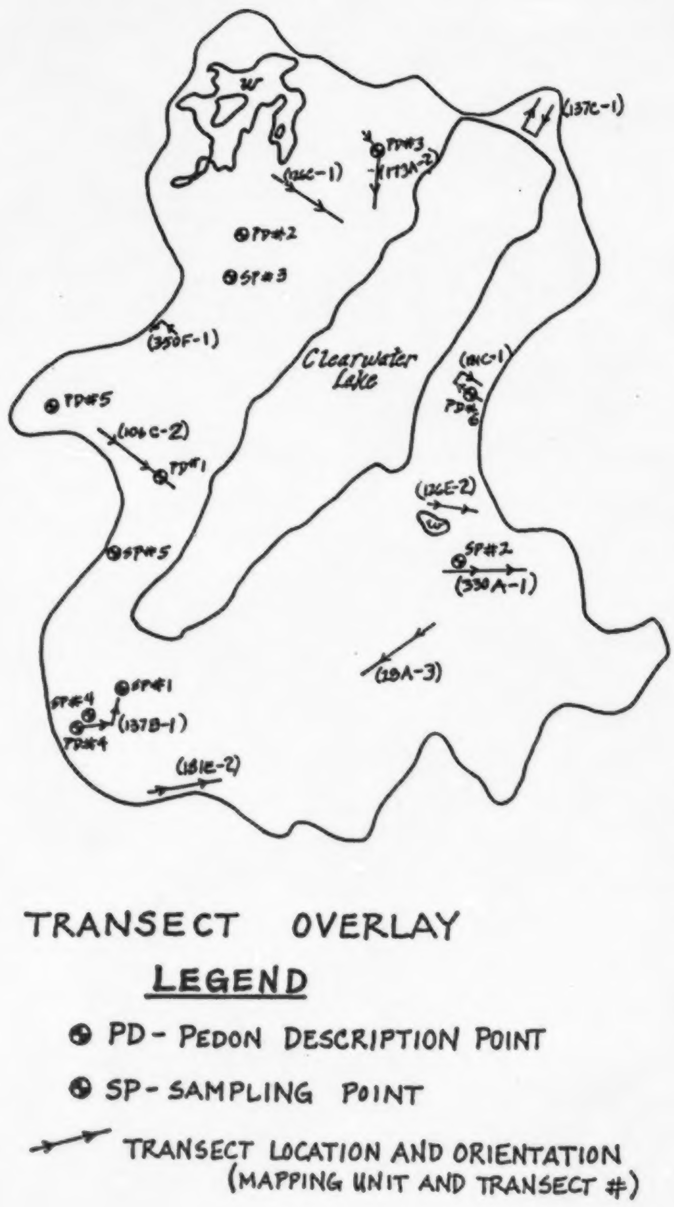

W
O
PD#3
(126C-1)
(173A-2)
(137C-1)
PD#2
SP#3
(350F-1)
Clearwater Lake
(181C-1)
PD#6
PD#5
(106C-2)
PD#1
(126E-2)
W
SP#2
(350A-1)
SP#5
(19A-3)
SP#1
SP#4
(137B-1)
PD#4
(181E-2)
TRANSECT OVERLAY
LEGEND
PD - PEDON DESCRIPTION POINT
SP - SAMPLING POINT
TRANSECT LOCATION AND ORIENTATION (MAPPING UNIT AND TRANSECT #)

Figure 3-2 Transect Overlay (example)

As part of field mapping, soil scientists determine available transects that represent map unit delineations.

- At least one available transect is identified for each map unit delineation. Additional available transects are identified in large delineations at a ratio of about 1 transect per 160 acres. Available transects for each kind of map unit are numbered sequentially beginning with the number 1. For example, the 3rd delineation of map unit 126C is identified by the transect code 126C-3. Available transects are listed by numbering sequentially to the right of the name of the map unit in the soil legend on the soil overlay. (eg. 126C...Alpha sandy loam 2 - 8 % slopes....1,2,3,4; shows there are 4 available transects of map unit 126C.)

- Transects usually are oriented at right angles to drainage patterns and cross most of the delineation, include most of the range in elevation, and represent the typical landscape of the area delineated.

- Soil Scientists conduct a minimum of one transect of each different map unit in a watershed with ten or fewer map units. Watersheds with more than 10 map units will have the minimum ten transects plus half of the number of map units greater than 10 (e.g., a watershed with 18 map units would have 10 plus half of 8 or a total of 14 map units transected). In this example, 14 map units to transect would be randomly selected from the 18 map units on the watershed. A map unit selected is indicated with an asterisk (*) to the left of the map symbols in the legend. A transect for each map unit is randomly selected from the list of available transects for the map unit.

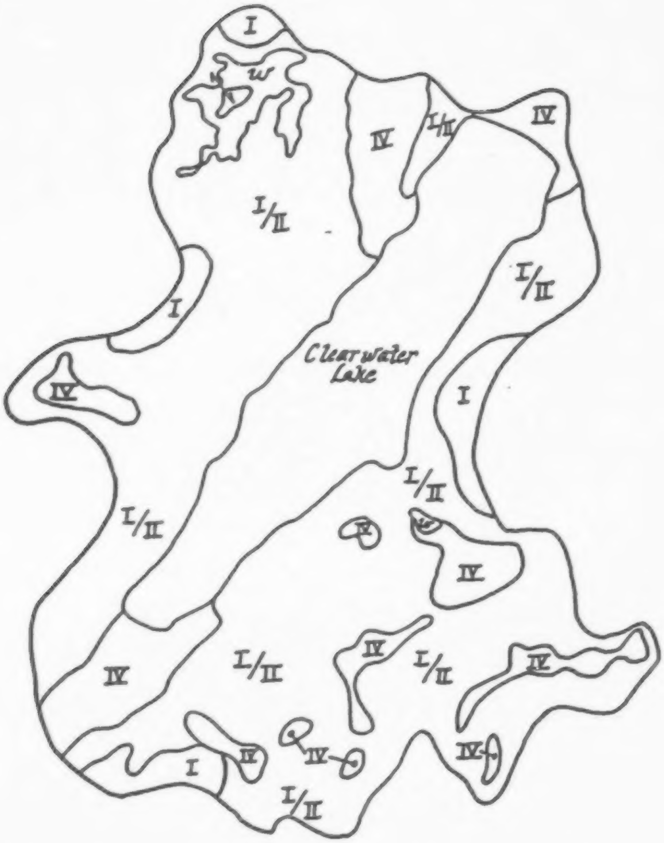
- Each selected transect is indicated by circling the corresponding number in the legend and located on the transect overlay of the watershed. Transects are labeled with the map unit symbol and number of the available transect that was selected (Figure 3-1).

- Data points along random transects are determined by the point intercept method at 10 equally spaced observations along each transect. Shape of transects (e.g., straight-line, dog-leg or zig-zag) are determined by the shape and size of the delineation. Distance between observations varies depending on the length of the transect (minimum distance = 10 meters).

- Transect data are recorded on the Soil Transect Data Sheet (Figure 2-3). A transect code consisting of the watershed code, map unit symbol and available transect number (eg. 2Z01234-126C-3) are recorded on the transect data sheet. Soil characteristics recorded on the transect data sheet are used to document the kind of soil that occurs at the observation point and whether the soil is similar or dissimilar to soil components described for the map unit. Soils similar to, but with properties outside, the official description are identified as taxadjuncts and noted as to how the soil is different. Transect data will support description of the range in characteristics of soil series mapped.

DEPTH-TO-BEDROCK MAPS

Depth to bedrock maps are made during the course of soil mapping. The maps are drafted on mylar overlays (Figure 3-3) registered to a topographic quadrangle map or orthophotoquad base


I
W
W
IV
I/II
IV
I/II
I
I/II
Clearwater Lake
IV
I
I/II
I/II
IV
IV
IV
I/II
IV
I/II
IV
IV
I
IV
IV
I/II

DEPTH TO BEDROCK OVERLAY

LEGEND

CLASS	DEPTH
I	LESS THAN 0.5 m.
II	0.5 - 1.0 m.
III	1.0 - 2.0 m.
IV	2.0 - 5.0 m.
V	5.0 - 30.0 m.
VI	> 30 m.

Figure 3-3 Depth to Bedrock Map (example)

map at a scale of 1:24,000. Each delineation on the soil map is assigned at least one, but no more than three of the six depth classes. A class is assigned for each major (named) soil of the map unit with a different depth class. The depth to bedrock map symbol for a delineation lists the depth to bedrock classes in decreasing order of estimated extent. From this survey, a depth to bedrock map on a mylar overlay is made by combining contiguous soil map delineations with the same depth to bedrock class. A soil map delineation may be segmented into more than one depth to bedrock class where necessary. Depth to bedrock is estimated from all available information including soils data, road cuts, and stream incisements. The depth-to-bedrock classes are listed in Table 3-1.

FOREST COVER MAPS

Landuse and forest cover type will be mapped on a mylar overlay of a 1:24,000 scale topographic quadrangle or orthophotoquad base map (Figure 3-4). Landuse is designated by one of the codes from Table 3-2.

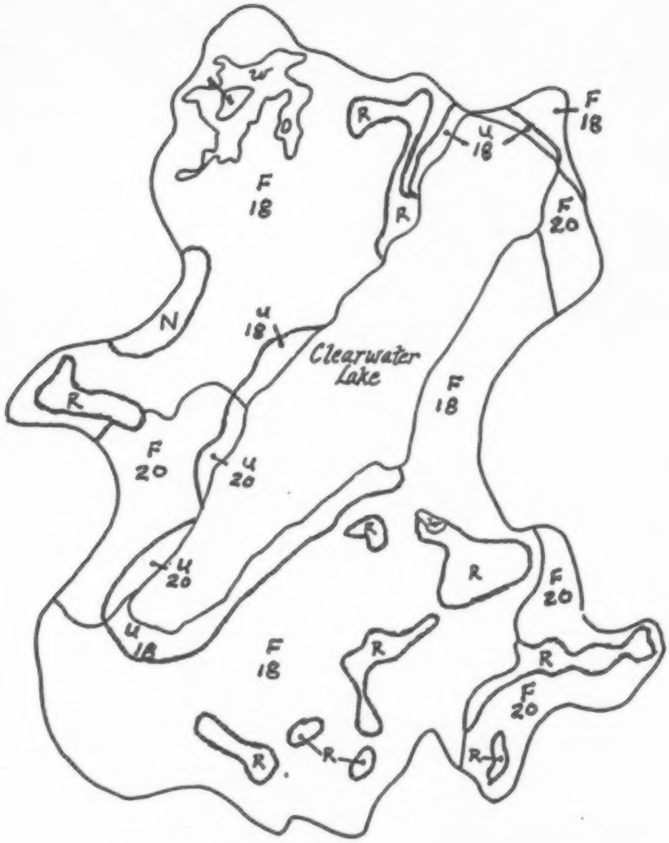
Landuse is easily confused with land type. Wetlands, barren land and tundra do not connotate a landuse per se, however, they do label segments of the land surface on which the use is limited because of their unique characteristics. The landuse of a forest clear-cut is forest and the forest cover type should be designated where possible. Forest cover is designated on a map overlay with the appropriate numeric code from the Society of American Foresters (SAF), (Eyre, F.H., 1980). Those delineations with forest cover are labeled with the landuse letter code above the forest cover type numeric code (e.g., F/52).

Delineations are made from aerial photograph imagery, and topographic and landscape features. Delineations are confirmed by field observation during the course of soil mapping. The area of each landuse and covertype is measured and tallied from the GIS after being digitized.

Cultural features including roads, mines, cabins or farmsteads, mine dumps, waste disposal areas and industrial sites too small to delineate are shown with conventional or special symbols on the Landuse/Forest Cover map.

Table 3-1 Depth-to-Bedrock Classes

Class	Depth, meters	Confidence Level
I	< 0.5	High
II	0.5 - 1	High
III	1 - 2	High
IV	2 - 5	Moderate
V	5 - 30	Low
VI	> 30	Low


W
F
18
R
U
18
F
18
R
F
20
U
18
N
Clearwater Lake
R
F
18
F
20
U
20
R
R
U
20
R
F
20
U
18
F
18
R
R
F
20
R
R
R

LAND USE AND FOREST COVER TYPES OVERLAY

LAND USE TYPES

SYMBOL	LAND USE
F	FOREST LAND NOT GRAZED
N	BARREN LAND
R	WETLANDS
U	URBAN AND BUILT-UP LAND

COVER TYPES

SYMBOL	TYPE
18	WHITE BIRCH
20	WHITE PINE, RED OAK, RED MAPLE

Figure 3-4 Landuse and Forest Cover Map (example)

Table 3-2 Landuse Codes

Landuse	Codes
Cropland	C
Forest land, grazed	E
Forest land. not grazed	F
Pasture land & native pasture	G
Horticultural land	H
Cropland, irrigated	I
Waste disposal land	L
Barren land	N
Rangeland, grazed	P
Rangeland, not grazed	S
Wetlands	R
Wetlands, drained	Q
Tundra	T
Urban & built-up land	U

DRAINAGE AND WATER FEATURE MAPS

Watershed drainages are shown on mylar overlays of topographic quadrangle base maps at a scale of 1:24,000. Standard map symbols are used to show all perennial streams, dominant (well-defined) intermittent stream channels, surface water bodies, and other water features on the overlay (Figure 3-5). The marsh or swamp symbol is used to show areas of less than two acres with standing water; larger marsh or swamp areas are delineated on the drainage overlay and labeled with an "S". The wet spot symbol is used to designate areas of less than 2 acres that are somewhat poorly drained or wetter and are two drainage classes wetter than the mapped soil. The upper end of perennial streams is shown with a short red line across the stream symbol. Incorrect drainages and drainage changes since publication of the topographic map need to be corrected or added.

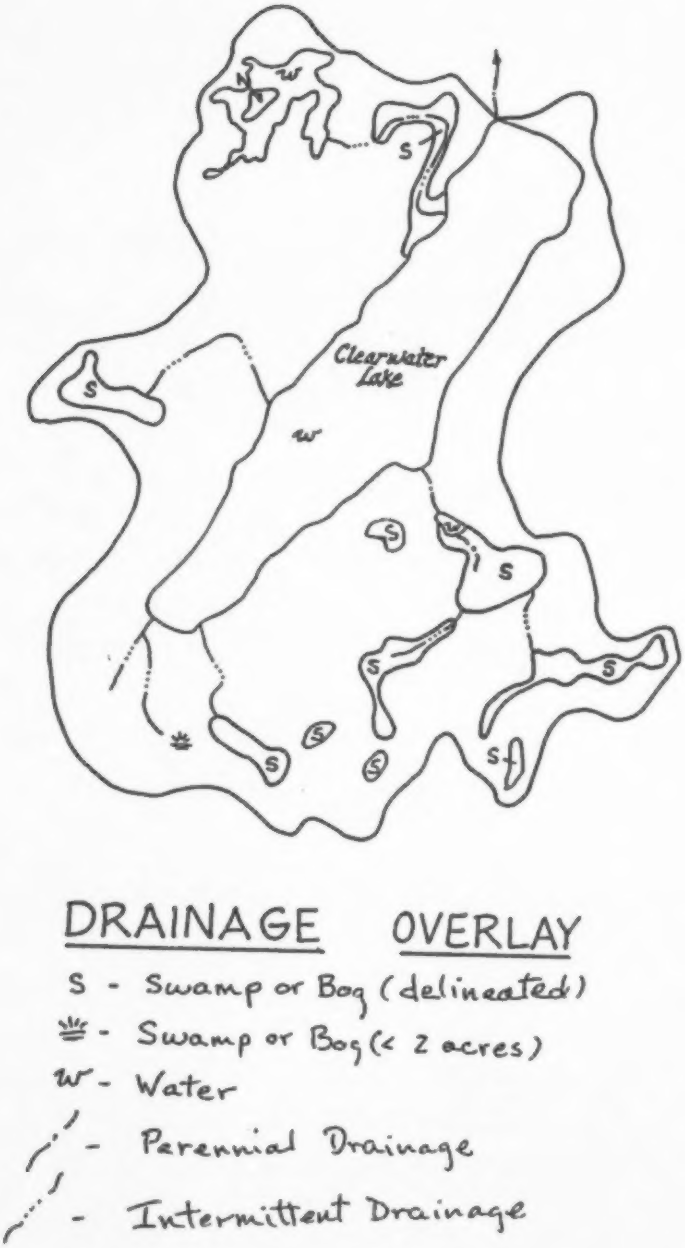

w
S
Clearwater Lake
w
S
S
S
S
S
S
S
S
S
DRAINAGE OVERLAY
S - Swamp or Bog (delineated)
- Swamp or Bog (< 2 acres)
w - Water
- Perennial Drainage
- Intermittent Drainage

Figure 3-5 Drainage Map (example)

4 MAPPING QUALITY ASSURANCE AND QUALITY CONTROL

APPROACH

Soil map quality can be judged by ground truth. Ground truth is the degree to which the map unit description accurately represents the "soilscape." Ground truth depends on: (1) accuracy and location of soil boundaries; (2) the correctness of information at each point investigated within the map unit delineation (Is it or is it not within the soils as described in the map unit?); (3) the overall correctness of the map unit description, including the total extent of inclusions. Boundary errors can be combined with correctness of information errors since, if the boundary is not located correctly, the correctness of information or classification of the land is in the "wrong" delineation and will be counted as an error. Evaluation of map quality has both quantitative and qualitative components.

Quantitative Component

A quantitative measure of the accuracy of a soil map is the proportion of the map area in which the reported soils information (the map unit description) is correct. In particular, each point on a soil map is included in a delineation. In turn, each map delineation represents a map unit which is described in the descriptive legend. An integral part of the description of each map unit is the relative proportion (%) of dissimilar soil components. This can be tested (by survey parties and/or independent observers) by examining point locations along transects within the map unit delineation in the field and comparing the frequency with which soils are observed to the percentages in the map unit description. For purposes of this soil survey, it is assumed that the scale, legend, and base map are adequate and the accuracy of the soil map (mapping) is to be evaluated.

A modification of the random transect method (Steers and Hajek, 1979) is used to quantitatively evaluate the correctness of the soil map units. This method is a procedure for random sampling of map units and a statistical method for analyzing field data.

Qualitative Component

The qualitative component of mapping quality requires independent review of the performance of the survey parties. Items that can be evaluated include adherence to protocols, identification of soils, placement of boundaries, note taking, and general accuracy and care with which delineations and watershed characteristics are recorded.

TASKS FOR SURVEY PARTIES

The soil survey party leader and soil mappers perform the first level of quality control. They must make decisions in the field that result in correct identification and description of soils, proper delineation and description of map units and diligent note taking. Their tasks are to produce the mapping products consistent with mapping protocols and standards recognized by the National Cooperative Soil Survey.

TASKS FOR (SCS) STATE SOILS STAFFS

A soil scientist from the soils staff of the SCS state office assigned responsibility for the survey party conducts field reviews. Each party participating in the soil survey is reviewed during the course of mapping. The review includes at least one watershed mapped by each soil survey party and is done in accordance with procedures specified in the National Soils Handbook Chapter 10, Progress Field Reviews (Soil Survey Staff, 1983). A written review report is submitted on the Field Review Report Form (Figure 4-1) to ERL-C and the RCC before the completion of mapping. Any deviations from the mapping protocol, and proposed corrective action, are reported to ERL-C and the RCC immediately. Emphasis is on the accuracy of the mapping, its consistency, and conformance with USEPA specified protocols for this survey. More specifically, the mapping is examined for soil identification, placement of boundaries, legibility, inclusions, conformance with descriptive legend and how well the map unit fits the proposed use of survey data. The adequacy of the field notes, and the general accuracy and care with which watershed characteristics were recorded, and are evaluated. About 25 percent of the soil map units in the watershed are traversed or transected by the soil scientist conducting the review. Data are recorded on the Map Adequacy Check Form (Figure 4-2) or Soil Transect Data Sheet (Figure 2-3) and evaluated. Corrective action recommended during the field review will be checked by the State Soils Staff after the required corrections have been made and initialed on the field review report form by the reviewer.

TASKS FOR REGIONAL COORDINATOR/CORRELATOR (RCC)

The RCC participates in at least one progress field review for SCS personnel in each state. About 20 percent of the mapped watersheds is selected by USEPA for independent evaluation by the RCC. About 20 percent of the map delineations in each of the watersheds is selected for transecting by the RCC. Transecting by the RCC is conducted in the same manner as specified for routine transects. The RCC also evaluates mapping on the selected watersheds by aerial photograph interpretation and traversing of 20 to 50 percent of the map units.

MAPPING FIELD REVIEW REPORT FORM
FOR THE
DIRECT/DELAYED RESPONSE PROJECT

(Format and appropriate content from SCS Field Review Report Form SCS-SOI-233)

1. GENERAL

1.1 Watershed Data

1.1.1 Watershed Number ______________________________

1.1.2 Watershed Name ______________________________

1.1.3 County and State ______________________________

I.1.4 Watershed Area ______________________________ acres

I.I.5 Mapped Area ______________________________ acres

I.2 Administrative Data

1.2.1 Date of Review ______________________________

I.2.2 Person(s) conducting review ______________________________

1.2.3 Mapping Team Leader ______________________________

I.2.4 Other Team Members ______________________________

____

1.2.5 Other Review Participants ______________________________

____

2. REVIEW OF MAPS AND DOCUMENTATION

2.1 Maps

2.1.1 Are recent aerial photographs being used? ______________

2.1.2 Base Map ______________ Scale ______________

2.1.3 Are overlays registered to base map? ______________

2.1.4 Has one overlay been used where quad sheets join? ______________

Figure 4-1 Field Review Report Form

2.1.5 Have overlays been prepared? Soils________Soil Transect____________

Landuse/Forest Cover____________Depth to Bedrock________________

Geology______________________Drainage___________________________

2.1.6 Are map symbols in all delineations?_____________________________

2.1.7 Are symbols legible and oriented?________________________________

2.1.8 Have hydric and alluvial areas been mapped at greater intensity?

____

2.1.9 Have conventional and special symbols been used where appropriate?

____

2.1.10 Soils

(a) Are soil map symbols in the regional legend?___________________

(b) What new map units are proposed in this watershed?_____________

____

(c) Have new map unit symbols and Soil Map Unit Worksheet(s) been submitted to RCC?____________________________Date__________

2.1.11 Landuse/Forest Cover

(a) Are the specified landuse and cover type symbols used?_________

(b) Do all delineations have a landuse symbol?___________________

(c) Do all forested areas have cover type symbols?_______________

2.1.12 Depth to Bedrock

(a) Do depth to bedrock map delineations correspond to soil map delineations?____________________If not explain_______________

____

(b) Do depth to bedrock classes correspond to soil depths:__________

(c) If complex (multiple) depth to bedrock classes were used , are the classes listed in decreasing order of extent?_____________

Figure 4-1 Field Review Report Form (continued)

2.1.13 Geology

(a) Does the state map adequately portray the bedrock geology of the watershed? If not, have changes been indicated on a mylar overlay?____

(b) Are geology map symbols the same as on the reference map? (check upper case vs lower case letters)________________________

(c) Has the reference for corrections to the geology overlay been given?____

(d) Are descriptions of geologic units, not on the state geology base map, correlated with the state geology map?______________

2.1.14 Drainage

(a) Are perennial and intermittent streams shown on a drainage overlay using standard symbols?________________________

(b) Is the difference between a perennial stream and intermittent stream cartographically precise?________________________

(c) Are lakes, reservoirs and other surface water bodies correctly located on the drainage overlay?________________________

(d) Are there any diversions of surface water into or out of the watershed?____

(e) Is the watershed boundary correctly located on the watershed divide?____

(f) Was the watershed boundary checked in the field to verify interpretation from topographic contour lines or aerial photography?____

(g) Do drainages conform to topographic map crenulations?________

Figure 4-1 Field Review Report Form (continued)

2.1.15 Are map symbols, map unit names, and area of each map unit in acres (soils overlay only),in a map legend on the map sheet:

Soils?____

Landuse?____

Forest Cover Type?__________________________________
Depth to Bedrock Class?______________________________

Bedrock Geology?___________________________________

2.2 Documentation

2.2.1 Soil Taxonomic Units

(a) Which soil components of map units have been described on this watershed?____________________________________

____

____

(b) Are the soil descriptions adequate and correct?____________

(c) Are additional descriptions needed?____________________

2.2.2 Soil Map Units

(a) Is there a Soil Map Unit Worksheet or map unit notes for each map unit in the watershed?____________________________

(b) Are differences in map unit composition for this watershed indicated on the map unit worksheet?____________________

(c) Is the information on the map unit worksheet complete and correct?____

2.2.3 Soil Transects

(a) Is there a soil transect for each map unit in the watershed as prescribed in the protocol?____________________________

Figure 4-1 Field Review Report Form (continued)

(b) Are map units to transect being randomly selected where there are more than 10 map units per watershed?________________

(c) Are transects being randomly selected from a list of available transects for each map unit?________________________

(d) Are available transects located on the transect overlay and transect direction indicated?________________________

(e) Are the Soil Transect Data Sheets complete and correct?_______

(f) Do transect data verify the map unit is correct?___________

3. MAPPING EVALUATION

3.1 Do map unit boundaries conform to the natural landscape?___________

3.2 Do soils mapped reflect differences in parent material origin and mode of deposition?_______________________________________

3.3 Is the soil map line intensity about right for the scale of mapping and topographic features?__________________________________

3.4 Does a random traverse of the watershed indicate the mapping is correct?____

3.5 Are soils mapped and correlated to distinguish important soil characteristics that influence waterflow and soil water chemistry in the watershed?

(a) Soil depth______________________________

(b) Parent Material__________________________

(c) Soil Drainage____________________________

(d) Soil Permeability_________________________

(e) Particle-size Class________________________

(f) Organic Matter___________________________

(g) Diagnostic Horizons________________________

Figure 4-1 Field Review Report Form (continued)

4. RESULTS AND SIGNATURE

4.1 Deficiencies noted during review:________________________________

4.2 Corrective action required:________________________________

4.2.1 Corrective Action Completed

(a) Date corrective action completed____________________

(b) Mapper: Initials______________Date______________

(c) Reviewer: Initials______________Date______________

4.3 Is mapping acceptable (soil, landuse/forest cover, drainage, depth to bedrock, geology)?______________Explain if not acceptable:

4.4 Comments:________________________________

4.5 Signature of Reviewer________________________Date__________

Figure 4-1 Field Review Report Form (continued)

MAP ADEQUACY CHECK FORM
USEPA-SCS
DIRECT/DELAYED RESPONSE PROJECT

Watershed No:______________
Mapped by:________________
Evaluated by:______________
Size Area Evaluated:
(1/2 sq. mi. or other______)

Date:________________________
Traverse No:________________
Evaluation Results
(Acceptable Unacceptable)

(0 - No deviation) (1 - One deviation from Expected) (2 - Two deviations from Expected)

Stop No	Map Unit Symbol	Depth to Rock or Slowly Perm	Drainage Class	Family Texture	Parent Material Mode/Origin	Comments

Figure 4-2 Map Adequacy Check Form

5 REFERENCES

Eyre, F. H. 1980. Forest Cover Types of the United States and Canada. Society of American Foresters, Washington, D.C.

Soil Survey Staff. 1983. National Soils Handbook. US Government Printing Office, Washington, D.C.

Soil Survey Staff. 1975. Soil Taxonomy. USDA Soil Conservation Service. Agricultural Handbook No. 436. US Government Printing Office, Washington, D.C.

Steers, C. A. and B. F. Hajek. 1979. Determination of map unit composition by a random selection of transects. Soi. Sci. Soc. Amer. Jour. 43:156-160.

APPENDIX B:

DIRECT/DELAYED RESPONSE PROJECT: SOIL LEGEND FOR ADDITIONAL MAPPING IN THE NORTHEASTERN REGION OF THE UNITED STATES

DIRECT/DELAYED RESPONSE PROJECT: ADDITIONAL NORTHEAST SOIL LEGEND

MAP SYMBOL	ACCESSORY SYMBOL(S)	AREA (ACRES)	MAP UNIT NAME
0W	(995Z)	2440	WATER
1A		17	ADAMS LOAMY SAND, 00-03% SLOPES
1B		65	ADAMS LOAMY SAND, 03-08% SLOPES
1C		420	ADAMS LOAMY SAND, 08-15% SLOPES
1D		21	ADAMS LOAMY SAND, 15-25% SLOPES
2A		70	ADRIAN MUCK, 00-03% SLOPES
12E		55	ARNOT-ROCK OUTCROP COMPLEX, 15-45% SLOPES
12F		11	ARNOT-ROCK OUTCROP COMPLEX, 45-70% SLOPES
20B		24	BECKET FINE SANDY LOAM, 03-08% SLOPES
20C		250	BECKET FINE SANDY LOAM, 08-15% SLOPES
20D		273	BECKET FINE SANDY LOAM, 15-25% SLOPES
21C		157	BECKET-LYMAN FINE SANDY LOAMS, 03-15% SLOPES
22B		125	BERKSHIRE FINE SANDY LOAM, 03-08% SLOPES
22C		445	BERKSHIRE FINE SANDY LOAM, 08-15% SLOPES
22D		363	BERKSHIRE FINE SANDY LOAM, 15-25% SLOPES
22E	369E	104	BERKSHIRE FINE SANDY LOAM, 25-45% SLOPES
30A		17	BOROSAPRISTS-FLUVAQUENTS COMPLEX, 00-03% SLOPES, DYSIC
32A	(107A)	58	BRAYTON FINE SANDY LOAM, 00-03% SLOPES
32B		68	BRAYTON FINE SANDY LOAM, 03-08% SLOPES
38B		202	CANTON FINE SANDY LOAM, 03-08% SLOPES
38C		192	CANTON FINE SANDY LOAM, 08-15% SLOPES
38D		116	CANTON FINE SANDY LOAM, 15-25% SLOPES
41A		113	CARLISLE MUCK, 00-03% SLOPES
45C		270	CHARLTON FINE SANDY LOAM, 08-15% SLOPES
45D		227	CHARLTON FINE SANDY LOAM, 15-25% SLOPES
45E		61	CHARLTON FINE SANDY LOAM, 25-45% SLOPES
46C	(995Z)	699	CHARLTON-CHATFIELD FINE SANDY LOAMS, 03-15% SLOPES
46D		174	CHARLTON-CHATFIELD FINE SANDY LOAMS, 15-25% SLOPES
47C	250C	25	CHATFIELD-HOLLIS-CHARLTON FINE SANDY LOAMS, 03-15% SLOPES
48E		39	CHATFIELD-HOLLIS FINE SANDY LOAMS, 15-45% SLOPES
51C		39	CHESUNCOOK SILT LOAM, 08-15% SLOPES
52A		125	CHIPPEWA SILT LOAM, 00-03% SLOPES
54A		31	COLTON GRAVELLY LOAMY SAND, 00-03% SLOPES
54B		172	COLTON GRAVELLY LOAMY SAND, 03-08% SLOPES
54C		535	COLTON GRAVELLY LOAMY SAND, 08-15% SLOPES
54D		198	COLTON GRAVELLY LOAMY SAND, 15-25% SLOPES
54E		135	COLTON GRAVELLY LOAMY SAND, 25-45% SLOPES
57A		158	CROGHAN LOAMY SAND, 00-03% SLOPES
57B		193	CROGHAN LOAMY SAND, 03-08% SLOPES
59C		84	DANFORTH CHANNERY SILT LOAM, 08-15% SLOPES
71A	72A	27	FLUVAQUENTS VARIABLE, 00-03% SLOPES, FREQUENTLY FLOODED, MESIC
76C		23	GLOUCESTER SANDY LOAM, 08-15% SLOPES
79A		118	GREENWOOD-OSSIPEE MUCKS, 00-03% SLOPES
86D		61	HERMON SANDY LOAM, 15-25% SLOPES
86E		17	HERMON SANDY LOAM, 25-45% SLOPES
89B	89A	45	HINCKLEY GRAVELLY SANDY LOAM, 03-08% SLOPES
89D	89C, 234D	166	HINCKLEY GRAVELLY SANDY LOAM, 15-25% SLOPES
96B		268	LACKAWANNA CHANNERY LOAM, 03-08% SLOPES

DDRP: ADDITIONAL NORTHEAST SOIL LEGEND (continued)

MAP SYMBOL	ACCESSORY SYMBOL(S)	AREA (ACRES)	MAP UNIT NAME
96C		200	LACKAWANNA CHANNERY LOAM, 08-15% SLOPES
96D		61	LACKAWANNA CHANNERY LOAM, 15-25% SLOPES
98B	512A	255	LEICESTER FINE SANDY LOAM, 03-08% SLOPES
103A	243A	206	LOXLEY-BESEMAN MUCKS, 00-03% SLOPES
105C		29	LYMAN FINE SANDY LOAM, 08-15% SLOPES
106C		28	LYMAN-ROCK OUTCROP COMPLEX, 03-15% SLOPES
107A		50	LYME FINE SANDY LOAM, 00-03% SLOPES
115B		35	MARLOW FINE SANDY LOAM, 03-08% SLOPES
115C		95	MARLOW FINE SANDY LOAM, 08-15% SLOPES
116D		10	MASARDIS FINE SANDY LOAM, 15-25% SLOPES
120A		42	MERRIMAC SANDY LOAM, 00-03% SLOPES
120B	120C	148	MERRIMAC SANDY LOAM, 03-08% SLOPES
122B		128	MONADNOCK FINE SANDY LOAM, 03-08% SLOPES
122C		459	MONADNOCK FINE SANDY LOAM, 08-15% SLOPES
122D		451	MONADNOCK FINE SANDY LOAM, 15-25% SLOPES
122E		39	MONADNOCK FINE SANDY LOAM, 25-45% SLOPES
123A		292	MONARDA SILT LOAM, 00-03% SLOPES
123B		276	MONARDA SILT LOAM, 03-08% SLOPES
125C		80	MONSON SILT LOAM, 08-15% SLOPES
129B		453	MORRIS LOAM, 03-08% SLOPES
134A		26	NAUMBURG LOAMY SAND, 00-03% SLOPES
138A		99	NORWICH LOAM, 00-03% SLOPES
141B		146	OQUAGA CHANNERY LOAM, 03-08% SLOPES
141C		21	OQUAGA CHANNERY LOAM, 08-15% SLOPES
141D		196	OQUAGA CHANNERY LOAM, 15-25% SLOPES
141E		229	OQUAGA CHANNERY LOAM, 25-45% SLOPES
142B		36	OQUAGA-ARNOT COMPLEX, 03-08% SLOPES
142C	11C	46	OQUAGA-ARNOT COMPLEX, 08-15% SLOPES
142E		139	OQUAGA-ARNOT COMPLEX, 25-45% SLOPES
144A		301	PALMS MUCK, 00-03% SLOPES
145B		111	PAXTON FINE SANDY LOAM, 03-08% SLOPES
145C		176	PAXTON FINE SANDY LOAM, 08-15% SLOPES
145E	145D	40	PAXTON FINE SANDY LOAM, 15-45% SLOPES
148B		328	PERU FINE SANDY LOAM, 03-08% SLOPES
148C	148D	269	PERU FINE SANDY LOAM, 08-15% SLOPES
150B	(32B)	44	PILLSBURY LOAM, 03-08% SLOPES
151A		10	PIPESTONE LOAMY SAND, 00-03% SLOPES
161E		37	POTSDAM-TUNBRIDGE COMPLEX, 15-45% SLOPES
162E		47	RAWSONVILLE-HOGBACK FINE SANDY LOAMS, 15-45% SLOPES
167A		132	RIDGEBURY LOAM, 00-03% SLOPES
167B		36	RIDGEBURY LOAM, 03-08% SLOPES
172F		230	ROCK OUTCROP-LYMAN COMPLEX, 45-70% SLOPES, BOULDERY
173A		11	ROUNDABOUT SILT LOAM, 00-03% SLOPES
178A		35	MEDISAPRISTS-AQUENTS COMPLEX, 00-03% SLOPES
192B		114	SKERRY FINE SANDY LOAM, 03-08% SLOPES
192C		188	SKERRY FINE SANDY LOAM, 08-15% SLOPES
196C	146C	114	SUNAPEE FINE SANDY LOAM, 08-15% SLOPES
199B		201	SUTTON FINE SANDY LOAM, 03-08% SLOPES
199C	199D	105	SUTTON FINE SANDY LOAM, 08-15% SLOPES

DDRP: ADDITIONAL NORTHEAST SOIL LEGEND (continued)

MAP SYMBOL	ACCESSORY SYMBOL(S)	AREA (ACRES)	MAP UNIT NAME
204B		125	TELOS SILT LOAM, 03-08% SLOPES
213C		50	TUNBRIDGE FINE SANDY LOAM, 08-15% SLOPES
214C		129	TUNBRIDGE-BERKSHIRE FINE SANDY LOAMS, 03-15% SLOPES
214D	23D	291	TUNBRIDGE-BERKSHIRE FINE SANDY LOAMS, 15-25% SLOPES
215C		107	TUNBRIDGE-LYMAN FINE SANDY LOAMS, 08-15% SLOPES
215E		726	TUNBRIDGE-LYMAN FINE SANDY LOAMS, 15-45% SLOPES
217B		19	UDORTHENTS , 00-08% SLOPES, SMOOTHED
226A		48	WASKISH PEAT, 00-03% SLOPES
229B		663	WELLSBORO CHANNERY LOAM, 03-08% SLOPES
229C		181	WELLSBORO CHANNERY LOAM, 08-15% SLOPES
236B		532	WOODBRIDGE FINE SANDY LOAM, 03-08% SLOPES
236C		190	WOODBRIDGE FINE SANDY LOAM, 08-15% SLOPES
236D		45	WOODBRIDGE FINE SANDY LOAM, 15-25% SLOPES
240B		83	WYOMING-RIVERHEAD SANDY LOAMS, 03-08% SLOPES
240C		81	WYOMING-RIVERHEAD SANDY LOAMS, 08-15% SLOPES
240D		25	WYOMING-RIVERHEAD SANDY LOAMS, 15-25% SLOPES
250E		14	HOLLIS-ROCK OUTCROP COMPLEX, 15-45% SLOPES
252A		30	BRAYTON FINE SANDY LOAM, 00-03% SLOPES, RUBBLY
257A		18	TULLER SILT LOAM, 00-03% SLOPES
263F		71	ABRAM-LYMAN-RICKER COMPLEX, 45-70% SLOPES
271B		75	ONTEORA SILT LOAM, 03-08% SLOPES
272B		170	WILLOWEMOC CHANNERY SILT LOAM, 03-08% SLOPES
272C		144	WILLOWEMOC CHANNERY SILT LOAM, 08-15% SLOPES
273D		44	LEWBEACH CHANNERY SILT LOAM, 15-25% SLOPES
280C		63	HAWKSNEST-MONGAUP CHANNERY LOAMS, 03-15% SLOPES
280E		68	HAWKSNEST-MONGAUP CHANNERY LOAMS, 15-45% SLOPES
281B		14	MONGAUP CHANNERY LOAM, 03-08% SLOPES
281C		12	MONGAUP CHANNERY LOAM, 08-15% SLOPES
282D		399	BICE-WOODSTOCK-ROCK OUTCROP COMPLEX, 15-25% SLOPES
282E		242	BICE-WOODSTOCK-ROCK OUTCROP COMPLEX, 25-65% SLOPES
283B		170	BICE FINE SANDY LOAM, 03-08% SLOPES
283C		214	BICE FINE SANDY LOAM, 08-15% SLOPES
283D		145	BICE FINE SANDY LOAM, 15-25% SLOPES
283E		192	BICE FINE SANDY LOAM, 25-45% SLOPES
284B		210	SCHROON SANDY LOAM, 03-08% SLOPES
285E	21E	180	BECKET-TUNBRIDGE-LYMAN FINE SANDY LOAMS, 15-45% SLOPES
359A	187A	515	WONSQUEAK MUCK, 00-03% SLOPES
360A		17	WONSQUEAK MUCK, 00-03% SLOPES, BOULDERY
361A		415	BUCKSPORT MUCK, 00-03% SLOPES
365C	365D	122	CHATFIELD-CANTON FINE SANDY LOAMS, 03-15% SLOPES
366F		29	CHATFIELD-CHARLTON FINE SANDY LOAMS, 45-60% SLOPES, BOULDERY
367E		137	CHARLTON FINE SANDY LOAM, 25-45% SLOPES, BOULDERY
368B		27	BECKET FINE SANDY LOAM, 03-08% SLOPES, BOULDERY
368C		47	BECKET FINE SANDY LOAM, 08-15% SLOPES, BOULDERY
370D		20	MONADNOCK FINE SANDY LOAM, 15-25% SLOPES, BOULDERY
370E		108	MONADNOCK FINE SANDY LOAM, 25-45% SLOPES, BOULDERY
371A		72	FINCH LOAMY SAND, 00-03% SLOPES
372E		119	MONADNOCK-LYMAN FINE SANDY LOAMS, 15-45% SLOPES, BOULDERY

DDRP: ADDITIONAL NORTHEAST SOIL LEGEND (continued)

MAP SYMBOL	ACCESSORY SYMBOL(S)	AREA (ACRES)	MAP UNIT NAME
373E		116	MONADNOCK-TUNBRIDGE FINE SANDY LOAMS, 15-45% SLOPES
374C		88	PLAISTED SILT LOAM, 08-15% SLOPES
375B		116	HOWLAND SILT LOAM, 03-08% SLOPES
376A		21	GREENWOOD PEAT, 00-01% SLOPES
377B		72	DIXFIELD FINE SANDY LOAM, 03-08% SLOPES
377C		35	DIXFIELD FINE SANDY LOAM, 08-15% SLOPES
378B		143	SHIRLEY VERY GRAVELLY FINE SANDY LOAM, 03-08% SLOPES, BOULDERY
380C		220	DANFORTH VERY GRAVELLY FINE SANDY LOAM, 08-15% SLOPES, BOULDERY
380D		204	DANFORTH VERY GRAVELLY FINE SANDY LOAM, 15-25% SLOPES, BOULDERY
380E		98	DANFORTH VERY GRAVELLY FINE SANDY LOAM, 25-45% SLOPES, BOULDERY
381C		25	DANFORTH VERY GRAVELLY FINE SANDY LOAM, 08-15% SLOPES, RUBBLY
381D		218	DANFORTH VERY GRAVELLY FINE SANDY LOAM, 15-25% SLOPES, RUBBLY
381E		65	DANFORTH VERY GRAVELLY FINE SANDY LOAM, 25-45% SLOPES, RUBBLY
382C		52	RUBBLE LAND, 03-15% SLOPES
383E		52	RAWSONVILLE-HOGBACK FINE SANDY LOAMS, 15-45% SLOPES, BOULDERY
384B		12	MAHOOSUC VARIANT MUCK, 03-08% SLOPES, BOULDERY
385F	48F	43	CHATFIELD-HOLLIS-ROCK OUTCROP COMPLEX, 45-60% SLOPES, BOULDERY
386E	214E	112	TUNBRIDGE-BERKSHIRE-LYMAN FINE SANDY LOAMS, 25-45% SLOPES
387F	215F	89	TUNBRIDGE-LYMAN FINE SANDY LOAMS, 45-70% SLOPES, BOULDERY
388A	(30A)	38	BOROSAPRISTS-FLUVAQUENTS COMPLEX, 00-03% SLOPES, EUIC
389A	(71A)	26	FLUVAQUENTS VARIABLE, 00-03% SLOPES, FREQUENTLY FLOODED, FRIGID
503A	503B	50	SUDBURY SANDY LOAM, 00-03% SLOPES
601A		129	MEDIFIBRISTS MUCKY PEAT, 00-03% SLOPES
602C		85	LACKAWANNA CHANNERY LOAM, 08-15% SLOPES, STONY
603D		112	LACKAWANNA CHANNERY LOAM, 15-25% SLOPES, RUBBLY
604C		32	LORDSTOWN CHANNERY LOAM, 08-15% SLOPES
605B		370	BUCHANAN CHANNERY LOAM, 03-08% SLOPES
606B		982	CLYMER LOAM, 03-08% SLOPES
606C		478	CLYMER LOAM, 08-15% SLOPES
607C		120	HAZLETON CHANNERY LOAM, 08-15% SLOPES, STONY
607D		16	HAZLETON CHANNERY LOAM, 15-25% SLOPES, STONY
609B		121	ANDOVER CHANNERY LOAM, 03-08% SLOPES
732A	379A(138A)	40	HAPLAQUEPTS-HUMAQUEPTS COMPLEX, 00-03% SLOPES, FRIGID

APPENDIX C:

DIRECT/DELAYED RESPONSE PROJECT:

QUALITY ASSURANCE PLAN FOR ADDITIONAL MAPPING IN THE NORTHEASTERN REGION OF THE UNITED STATES

by

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1 SIGNATURE PAGE

QUALITY ASSURANCE PLAN FOR ADDITIONAL MAPPING ACTIVITIES OF THE DIRECT/DELAYED RESPONSE PROJECT IN THE NORTHEASTERN REGION OF THE UNITED STATES

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Date

2 LIST OF FIGURES

There are no figures.

3 LIST OF TABLES

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4 INTRODUCTION

QUALITY ASSURANCE (QA)

The quality assurance program of the US Environmental Protection Agency (USEPA) is designed to ensure that the collection of data by monitoring and measurement projects are scientifically sound, legally defensible, and of known quality. Every monitoring and measurement project must have a written and approved QA Project Plan to document the policies, organization, functional activities, and specific QA and quality control (QC) activities that are designed to achieve the data quality goals of the project. This document presents the QA plan for the mapping activities of the USEPA's Direct/Delayed Response Project (DDRP) in the Mid-Appalachian Region and the additional mapping in the Northeast (NE) Region. The mapping activities are part of the DDRP Soil Survey, which includes soil sampling and characterization. The protocols for these mapping activities are presented in Appendix A.

QA Requirements

It is the policy of the USEPA that each office or laboratory generating data must implement procedures to ensure that precision, accuracy, completeness, comparability and representativeness of data are known and documented (Quality Assurance Management Staff (QAMS), 1980). A written QA Plan is required to specify the quality levels that the data must satisfy to be acceptable for the intended use.

QA ELEMENTS

Nineteen elements (Table 1-1) must be included for consideration in a QA Project Plan (QAMS, 1980). The first two elements are a title page with provision for appropriate signatures and a table of contents. The other fourteen elements are sections two through sixteen in the table of contents.

Table 1-1 ELEMENTS OF A QA PLAN

Section	Element
1	Signature page
2	List of figures
3	List of tables
4	Introduction
5	Project description
6	Project organization and responsibility
7	QA objectives for measurement data in terms of accuracy, precision, completeness, representativeness and comparability
8	Sampling procedures
9	Sample custody
10	Calibration procedures and frequency
11	Analytical procedures
12	Data reduction, validation and reporting
13	Internal quality control checks and frequency
14	Performance and systems audits
15	Preventative maintenance
16	Specific routine procedures used to assess data precision, accuracy and completeness
17	Corrective actions
18	Quality assurance reports to management
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5 PROJECT DESCRIPTION

PROJECT DESIGN

Soil Mapping Design

Soil mapping standards are based on those of the National Cooperative Soil Survey (NCSS). Federal leadership of the NCSS is provided by the US Department of Agriculture - Soil Conservation Service (SCS). The standards are defined in the National Soils Handbook (Soil Survey Staff (SSS), 1983). The soil classification system used by the NCSS is Soil Taxonomy (SSS, 1975).

The intensity of this soil survey is order two, as defined by the SCS (SSS, 1983) which means that each map delineation is identified by traversing it and that the type of map units used are consociations, complexes, and, occasionally, undifferentiated groups. In this survey, the map scale is 1:24,000. The minimum size of delineations, which is the smallest size in which the map unit symbol can be printed easily, is about six acres; only hydric and alluvial soils are delineated at 2 to 6 acres. Small features are represented by special symbols.

Map units are collections of soils or miscellaneous areas grouped together to represent landscape units. Specifications of map units can be found in the National Soils Handbook (SSS, 1983). Map units are described in terms of ranges of soil characteristics and the types of similar and dissimilar soils commonly found within the unit. Similar soils share many properties and behavior which make them similar for the purposes of a survey, but differ by no more than two or three criteria that separate them from the principal soil according to Soil Taxonomy (SSS, 1975). Dissimilar soils differ in important diagnostic properties and/or use and management considerations. Areas of similar, dissimilar soils and miscellaneous areas found in a map unit, but not identified in the map unit name, are termed inclusions. Definitions (SSS, 1983) of the types of map units used in this survey are:

- consociations are map units in which at least 75 percent of the soils fit within the range of a given taxon or miscellaneous area. The amount of dissimilar inclusions should not exceed 15 percent.
- complexes are map units in which two or more kinds of soil occur in a pattern that repeats; but is so intricate that components cannot be separately delineated at the mapping scale specified. Each named component of the complex occupies a significant portion of the delineation. No single dissimilar soil should occupy more than 10 percent of the area and all dissimilar soils combined should not exceed 15

percent. In the name of a complex the named soils are combined with a dash.

- undifferentiated groups are map units in which two or more kinds of soil occur but are not consistently found in regular patterns. The components are similar soils with similar uses. Each delineation need not have all the components present. No single dissimilar soil should occupy more than 10 percent of the area and all dissimilar soils combined should not exceed 15 percent.

The descriptive legend is designed to be uniform and consistent for the entire region. The descriptive legend is composed of three parts: descriptions and classification of soils, an identification legend and a conventional and special symbols legend. The description and classification of soils section contains information about taxonomic units (components of map units). Taxonomic units are described by name, parent material mode of deposition and origin, depth to bedrock, depth to restricting layers, drainage class, permeability, hydrologic group and taxonomic classification. The identification legend consists of a list of symbols to identify soil map units. The conventional and special symbols legend consists of symbols used to identify artificial works and structures, boundaries and drainage. Included are symbols for identifying areas of soil, special features or miscellaneous areas too small to be delineated at the scale of mapping.

Map unit descriptions contain the map symbol, name of the map unit, dominant landforms and geomorphic positions commonly found on, slope configuration, soil components with percent estimates and additional notes.

Depth to Bedrock Mapping Design

Survey parties prepare depth to bedrock maps based on the depth of the mapped soils. The party estimates depth to bedrock from examination of soils, roadcuts, excavations and stream incisements. The mapping is transferred to mylar overlays on a USGS quadrangle or orthophotoquad at a scale of 1:24,000. One to three depth classes are assigned to each map delineation. The depth to bedrock classes should reflect major soils in the delineation, not map unit inclusions. The depth to bedrock symbol for a map delineation lists the depth to bedrock classes in descending order of estimated extent. Adjacent map delineations with the same depth to bedrock symbol(s) are combined for the final map. Where appropriate a soil map delineation may be segmented into more than one depth to bedrock class.

Landuse and Forest Cover Mapping Design

Survey parties prepare landuse and forest cover maps from field study. The mapping is transferred to mylar overlaying USGS quadrangles or orthophotoquads at a scale of 1:24,000. Landuse is designated by the landuse codes used on the SCS Soil Description Form. Forest cover numeric codes used are those of the Society of American Foresters (Eyre, 1980).

Drainage

Drainage features maps are prepared on mylar overlays on a USGS quadrangle or orthophotoquad at a scale of 1:24,000. Standard map symbols shown in the mapping protocols (Lammers et al, 1988) are used to show all perennial streams, dominant (well-defined) intermittent streams, water bodies and other water features. Marsh or swamp symbols are used to show areas less than two acres with standing water; larger marsh or swamp areas are delineated on the overlay and labelled "S". The upper end of perennial streams are marked with short red lines across stream symbols. If using a USGS topographic map care should be exercised to make any corrections to changes in drainage since the original topographic map was prepared.

6 PROJECT QUALITY ASSURANCE (QA) ORGANIZATION AND RESPONSIBILITY

PROJECT ORGANIZATION

The Mapping Task Leader from ERL-C had overall responsibility for the field activities and the documentation of methods, field operations, and data quality. The Mapping Task Leader maintained the mapping information database that contains the identification legend, the classification, and description of map unit composition.

The RCC was an independent contractor who provided QA/QC oversight for the fieldwork. The RCC maintained a uniform, consistent regional mapping legend, participated in at least one field review for each state as an audit of field mapping procedures and mapping quality, and evaluated the quality of the mapping in 20 percent of the watersheds.

The SCS State Soil Scientists for ME, NY, and PA, with the support of the State Soils Staff, were responsible for the field activities by personnel from their state. This included supervising and coordinating field crews, conducting at least one progress field review as an audit of each soil survey party, working with the RCC to ensure regional consistency, forwarding completed maps with field notes to the Mapping Task Leader, and participating in training field crews.

The DDRP ERL-C QA Coordinator worked with the QA Staff of ERL-C to coordinate and document QA/QC activities. The QA Coordinator evaluated final map quality with the Mapping Task Leader, helped coordinate the QA/QC activities of ERL-C geographers, and was responsible for the preparation of the Field Operations and QA report.

The Soil Survey Parties, led by a soil scientist, mapped the watersheds, described soils and soil map units, and conducted transects across map delineations to determine map unit composition.

PROJECT RESPONSIBILITY

Soil Survey Parties

The soil scientists assigned to conduct the mapping had the following responsibilities:

- conducted field investigations and aerial photo interpretation in order to delineate map units,
- traversed or visited all map delineations in the field,
- recorded observations and problems systematically in field notes, and

- conducted randomly selected transects used in the determination of soil map unit composition.

USDA-SCS State Soils Staffs

The State Soils Staffs had the following responsibilities:

- maintained a uniform and controlled legend by coordinating and correlating soils and map units,
- trained soil survey parties in and supervised adherence to the mapping protocols,
- conducted field reviews that were to include at least one watershed for each mapper,
- reported and resolved mapping problems in an expeditious and uniform manner,
- conducted follow-up reviews to ensure that any necessary corrective actions had been taken,
- prepared reports presenting results of the above tasks, and
- reviewed mapping products and sent the products to ERL-C.

Regional Coordinator/Correlator (RCC)

The Regional Coordinator had the following responsibilities:

- maintained a uniform and controlled legend by coordinating and correlating soils and map units,
- participated in training,
- conducted transects on selected map units to evaluate the correctness of the mapping,
- evaluated mapping on about 20 percent of the watersheds by aerial photography interpretation and field investigations,
- participated in at least one progress review for SCS personnel in each state,
- evaluated state field review reports (Appendix D), and
- prepared reports presenting the results of the above tasks.

Mapping Task Leader

The Mapping Task Leader had the following responsibilities:

- managed and directed the mapping,
- worked with the DDRP ERL-C QA Coordinator to coordinate and document QA/QC activities,
- developed mapping protocols,
- provided initial instruction on mapping activities,

- evaluated progress reviews,
- coordinated with the SCS and the RCC to ensure that any necessary corrective actions were taken to resolve identified problems,
- selected watersheds and transects to be evaluated by the RCC,
- received and stored all interim and final reports, maps and other products,
- supervised final map checks and corrective actions before maps were digitized, and
- maintained the mapping database.

QA Coordinator

The DDRP ERL-C QA Coordinator had the following responsibilities:

- prepared the QA Plan,
- evaluated final map products,
- coordinated review of final map with geographers,
- worked with the ERL-C QA Staff to ensure that QA requirements were being fulfilled
- facilitated the exit meeting, and
- prepared the Field Operations and QA Report.

7 PROJECT QA OBJECTIVES

The intent of the USEPA QA program is to ensure that data are collected that are scientifically sound, legally defensible, and of known quality (QAMS, 1980). Fields reviews which function as audits, transects across map delineations by the RCC and evaluation of the mapping by the RCC will be used to assess the quality of the field mapping.

DEFINITION OF QA OBJECTIVES

Quality assurance objectives are defined in terms of the following characteristics (QAMS, 1980):

- Accuracy
- Precision
- Representativeness
- Completeness
- Comparability

Accuracy and Precision

Accuracy is the degree of agreement of a measurement (or an average of measurements) with an accepted reference or true value. Accuracy is the degree to which mapping describes the true condition of watershed attributes. The accepted reference values used in this project are the expert judgments of the RCC and the State Soils Staff. Accuracy is affected by the scale and order of survey because different levels of detail are required at different scales.

Precision is a measure of mutual agreement among individual measurements of the same property. In analytical laboratory work, precision is the agreement of measurements on a sample made by the same lab and/or different labs. For a soil mapping project, precision cannot be defined in the same manner, because only one survey party maps a given delineation. If one considers map units with similar properties in different geographical locations as a property for comparison, then precision would be defined as how consistently mappers identify that map unit in different locations.

Completeness, Representativeness, and Comparability

Completeness is a measure of the amount of valid data obtained compared to the amount that was expected to be obtained under normal conditions. Representativeness expresses the degree to which data accurately and precisely represent characteristics of a population. Comparability is the confidence with which one data set can be compared with another.

DATA QUALITY OBJECTIVES (DQOs)

Mapping DQOs

Accuracy and precision are addressed in this section in general terms and are discussed more specifically in the following section. Representativeness, completeness and comparability are discussed in this section only because they are applied to the mapping activity as a whole.

Accuracy and Precision --

To assess accuracy for the mapping activities, the accepted reference or "true value" is considered to be the expert judgement of the RCC and State Soils Staff. The accuracy of a map delineation is its degree of conformity to the landscape. The accuracy of a map unit is its degree of conformity with the composition of soils or other watershed attributes in delineated areas (ground truth). For a map to accurately reflect the condition that is being mapped, the mapper must select the appropriate map unit to describe the watershed attribute and draft the appropriate map delineation boundaries.

Precision, for these mapping activities, is the degree of agreement between different mappers if they were to map a given attribute for the same or similar landscapes. In this project only one survey party maps a given area, thus, what is important in terms of precision, is that similar landscapes be mapped in the same manner. Training, adherence to protocols, and oversight by the RCC and the State Soils Staff ensures that watershed attributes are mapped consistently. Accuracy and precision are discussed below for each type of map overlay.

Representativeness --

Representativeness, for this project, is the degree which the mapping data collected accurately represents the actual condition of watersheds mapped. Procedures for ensuring representativeness are considered in the project design phase (Church et al., 1989).

Completeness –

The completeness objective for this project is 100 percent. If the mapping in any watershed is determined to be unacceptable by the RCC or State Soil Staff, then the watershed must be remapped. One situation that might limit attaining 100 percent completeness, is if mappers are denied access by property owners. Mappers must make every effort to gain watershed access including use of a letter from the USEPA to the landowner explaining the project or enlisting the help of local people to talk with landowners.

For the mapping data to be complete, the final map products delivered to ERL-C must be accompanied by supporting documentation. This documentation contains descriptions of map units supported by a minimum of one field note for each map unit on the watershed and a minimum of two pedon descriptions for each kind of soil series mapped. A copy of the Official Soil Series Description for each series mapped with the ranges of characteristics adjusted to reflect the soils mapped in the region are submitted. Transect data are submitted for randomly selected, 10-point transects for each different map unit on a watershed (all map units if 10 or less, otherwise the number of transected map units is 10 plus half the number of units greater than 10).

Comparability –

Comparability of mapping of one watershed to another within this soil survey is ensured by adherence to the same mapping protocols by all field crews with QA/QC checks by the RCC and State Soils Staff. Training field personnel about the protocols helps assure uniform interpretation and application of the mapping protocols. Comparability within a region is promoted by the use of uniform map legends.

The methods used in this soil survey make it comparable with the other DDRP soil surveys even though the surveys have different map legends and kinds of soil. Comparability of mapping in the DDRP Mid-Appalachian Soil Survey to DDRP soil surveys in the Northeast Region and Southern Blue Ridge Province is maintained by using the same general NCSS guidelines, the same scale and the same order survey. The major difference between this survey and other DDRP soil surveys is that the minimum size delineation in this survey for hydric and alluvial soils is 2 acres; whereas, in the Northeast and Southern Blue Ridge surveys the minimum delineation for all kinds of soils is 6 to 10 acres. Adherence to NCSS standards makes all the DDRP soil surveys comparable to soil mapping conducted by the NCSS.

Depth to bedrock mapping in the past DDRP surveys used the same legend and approach. Mapping activities in the Northeast did not include land use mapping by the soil survey parties. Bedrock geology for the past surveys was determined directly from state geology maps. State geology maps were used to determine bedrock geology for this survey.

Soil Mapping DQOs

Accuracy and Precision --

The quality objectives for soil mapping accuracy are that the mapper consistently choose the most appropriate map unit and that the map delineation boundary is drawn in the appropriate location. Map units are established using NCSS guidelines discussed in Section 5. If the mapper observes landscape units that do not fit the concept of any map unit on the legend, then either it is correlated to a similar map unit, or a new map unit is established. The accuracy of soil map delineation boundaries depends upon the use of landscape features that reflect the pattern of soils. For example, slope changes, drainage differences or vegetation may reflect the boundaries between different landscape segments that have different soils. Accuracy in soil mapping requires the use of such features, while mapping precision requires that when such relationships are observed, they are uniformly applied in the survey area.

Depth to Bedrock Mapping DQOs

Accuracy and Precision --

Observations made by the survey parties to estimate depth to bedrock classes are normally limited to observations while examining soils, road cuts, and stream incisements. The mappers delineate the depth to bedrock classes that correspond with the major soils in the map unit delineation. Soil surveys in populated areas can use well logs and road department drill logs to estimate depth to bedrock. Data of this type may not be available for watersheds in this survey however. The type of observations available give a good indication of the depth to bedrock where the bedrock is not extremely deep.

At two meters or less depth, the mapper should have enough information to accurately assess the depth to bedrock. Depth values should be as accurate as the soil mapping. At 2 to 5 m depth, the expected accuracy is lower than that above 2 m. At depth greater than 5 m, it is difficult to assess the accuracy of the mapper without coring equipment, ground penetrating radar or some other special technique that is outside the scope of this survey.

The assessment of accuracy and precision for depth to bedrock mapping is primarily done by the expert judgement of the RCC and State Soils Staffs with an additional check done by the evaluation of transect data.

Landuse and Forest Cover Mapping DQOs

Accuracy and Precision --

The mapping crews should have enough information available to determine landuse and forest cover. Direct observation can also be used to delineate landuse to the same accuracy as soil mapping. Survey party members must be trained to correctly identify landuse and forest map units.

Drainage Maps DQOs

Accuracy and Precision --

The accuracy goal for drainage maps is that they accurately reflect stream and water features as they occur at the time of mapping. USGS topographic maps may be used to aid in mapping.

The final drainage map should reflect field observation and aerial photo interpretations to account for possible changes that have occurred since the USGS maps were produced.

8 SAMPLING PROCEDURES

There are no sample collection activities required for the soil mapping activities.

9 SAMPLE CUSTODY

No samples are collected for soil mapping activities, and sample custody is not an issue.

10 CALIBRATION PROCEDURES AND FREQUENCY

There are no calibration procedures involved in soil mapping activities. The transects surveyed by the soil mappers is a type of calibration activity. In the course of mapping, a mapper chooses their own way of traversing and examining the landscape. Transects that were randomly chosen are a way of comparing the traverse chosen by the mapper. This functions as a calibration activity because transect observations may be different than the mapper's observations during mapping and can indicate that more field checking may be necessary.

Field reviews serve a calibration function by comparing the mapper's observations with other experienced soil scientists. The judgments of the review team also serves as a calibration or reference against which the mapper can compare observed pedon characteristics which the mapper uses for selecting map units and landscape interpretations. A crucial tool for accurate and precise placement of map delineation boundaries.

11 ANALYTICAL PROCEDURES

There are no analytical procedures involved with the soil mapping activities.

12 DATA REDUCTION, VALIDATION AND REPORTING

TRANSECT DATA

Transect data, from the survey parties (routine transects), will be used to determine map unit compositions. RCC transects will be used to evaluate the accuracy of map unit compositions and the accuracy of the mapping. Transect data will be entered into a data base at ERL-C. Map unit symbols and names will be corrected to reflect changes caused by correlation.

SUPPORTING DOCUMENTATION

Documentation must contain descriptions of map units supported by a minimum of one field note, which is a brief soil profile description, for each map unit on the watershed and a minimum of two pedon descriptions for soil series mapped. A copy of the SCS Official Soil Series Description for each series mapped adjusted to reflect the soils mapped in the region must be submitted to the Mapping Task Leader at ERL-C.

FINAL MAP PRODUCTS

All final maps must be prepared on mylar overlays registered to a 1:24,000 scale topographic map or orthophotoquad base map. Final maps showing transects accompanied by supporting documentation are submitted to the Mapping Task Leader.

13 INTERNAL QC CHECKS AND FREQUENCY

INTERNAL QC CHECKS BY SOIL SURVEY PARTY

The Survey Party Leaders have responsibility for adherence to mapping protocols and the performance of all mapping activities. As discussed above in Section 7 (Calibration), the transects done by the mappers serve a calibration function and as an internal QC check to identify problems as they occur.

14 PERFORMANCE AND SYSTEMS AUDITS AND FREQUENCY

AUDITS BY STATE SOILS STAFFS

To audit mapping parties, the State Soils Staffs will conduct at least one field review of watershed mapping for each survey party in accordance with guidelines for field reviews of the NCSS (SSS, 1983). A written report will be submitted to the RCC and ERL-C on the Field Review Report Form (Appendix A). Any deviations from mapping protocol found, including suggested and completed corrective actions must be reported to the RCC and ERL-C immediately.

AUDITS BY RCC

The RCC will participate in and document at least one progress field review of SCS personnel from each state. In addition, the RCC will review all the field review reports.

15 PREVENTATIVE MAINTENANCE PROCEDURES AND SCHEDULES

It is the responsibility of the State Soils Staff to keep the survey parties well supplied with necessary equipment and to maintain any equipment.

16 SPECIFIC ROUTINE PROCEDURES TO ASSESS QA OBJECTIVES

MAPPING EVALUATION BY THE RCC AND STATE SOILS STAFFS

The RCC independently evaluates mapping in about 20 percent of the watersheds as chosen by the USEPA. Twenty percent of the map delineations in selected watersheds are transected by the RCC. The RCC examines aerial photographs of the watersheds and traverses 20 to 50 percent of the map units. The RCC also participates in field reviews.

The State Soils Staff conducts at least one field review of watershed mapping for each survey party in accordance with NCSS guidelines for field reviews (SSS, 1983). Results of all field reviews should be documented and submitted to ERL-C.

ANALYSIS OF TRANSECT DATA

The transect data are evaluated in several ways. The proportions of all major components of the map units are estimated from routine transects. Transects done by the RCC will be compared with the map unit compositions estimated by the mappers using binomial distribution or the normal approximation to the binomial.

The map unit composition calculated from routine transects are compared to those of the RCC using Fisher's exact test (Fisher, 1935). This provides a check on the accuracy the selection of the map unit chosen for the map delineation. This also provides an indication of the accuracy of the map unit descriptions. The proportions of major components of map units determined from routine transects may have to be adjusted if there are significant differences between the RCC and routine transects.

FINAL MAP CHECKING AT ERL-C

A final check of map quality is done at ERL-C prior to digitization of the data. Soil scientists examine the maps to ensure that correct map symbols were used, that patterns of delineation follow the landscape, that the depth to bedrock classes agree with the soil depth classes and that slope classes generally agree with topographic maps. Geographers evaluate tic marks and registration, watershed boundaries, stream placement and the fit of the mapping to the geomorphology. The quality of landuse and forest cover mapping is evaluated by a forest soil scientist.

17 CORRECTIVE ACTION

The State Soils Staff makes recommendations to mappers on how to conform with protocols during field reviews and any deviations from protocols must be reported immediately to ERL-C. Major deviations may cause the State Soils Staff to recommend that areas be remapped. It is the responsibility of each State Soils Staff, in consultation with the RCC and the Mapping Task Leader, to determine what corrective actions are appropriate. Corrective actions that arise from field reviews are specified on the Field Review Report Form (Appendix A) and the reviewer makes sure that the corrective action has been done. Most of the corrective actions occur at the time of field reviews. The State Soils Staff must follow through to correct similar deficiencies on other watersheds.

The RCC is expected to make recommendations to mappers concerning the implementation of mapping protocols. The RCC must report mapping problems to ERL-C immediately and recommend corrective actions be taken. The RCC can recommend that remapping be done if there is a need.

The Mapping Task Leader and ERL-C will coordinate with the SCS and the RCC to ensure that necessary corrective actions are carried out. Corrective actions indicated by the final map checking process at ERL-C, require that the field mappers first be contacted for clarification. The Mapping Task Leader is responsible for assuring and documenting any corrective actions that are taken.

18 QA REPORTS

REPORTS OF THE STATE SOILS STAFFS

The State Soils Staff will submit Field Review Report Forms and any other supplemental documentation to ERL-C. The RCC and ERL-C will be contacted immediately if deviations from protocol are discovered.

REPORTS OF THE RCC

The RCC must prepare written reports and submit them to ERL-C regarding the evaluation of 20 percent of the watersheds mapped, review of state field review reports and the transects on selected watersheds. In the case of serious discrepancies, the RCC should contact ERL-C immediately.

FINAL QA REPORT

At the completion of the soil mapping activities the Soil Mapping Task Leader and ERL-C will prepare a final QA report documenting QA issues and the quality of the final map products.

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APPENDIX D:

DIRECT/DELAYED RESPONSE PROJECT:

REGIONAL COORDINATOR/CORRELATOR QUALITY ASSURANCE/QUALITY CONTROL REPORT ON ADDITIONAL SOIL MAPPING ACTIVITIES IN THE NORTHEASTERN REGION OF THE UNITED STATES

by

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1 REVIEW AND COMMENTS ON SOIL CONSERVATION SERVICE FIELD REVIEW REPORTS

In reviewing these reports, I have reviewed only the reports as written by the US Department of Agriculture, Soil Conservation Service (SCS) and have not commented based on my findings where I have reviewed or evaluated the same watershed. I have commented only on the adequacy of the report.

NEW YORK REPORTS

Triangle Lake - Watershed No. 1B3003

The review of this watershed was conducted on April 7, 1988. The map adequacy check sheet indicated that seven delineations were checked. There are 2 stops on unit 96D, but the check sheet did not indicate if this was 2 stops in the same delineation or 1 stop in each of 2 delineations. The total number of delineations on the map was not given on the report form. All questions on the report form were answered. In some cases, the question was not applicable to the watershed and was so indicated. The review report did not indicate that any issues of protocol, correlation, mapping or transecting were brought up during the review.

Section 2.2.2 of the report form indicates map unit work sheets were complete and accurate for the watershed. The review did not indicate if mapping notes were available or checked. A check of transect notes indicated map units were correct. Two soil components of map units were described in the watershed and found to be adequate and correct. The only corrective action indicated is the elimination of delineations that did not meet minimum size which was corrected at the review.

The review examined the mapping quality in accordance with the protocols; however, the report did not indicate the percentage of map units checked. The report indicated that all aspects of mapping were checked. The review report documented that the mapping was of acceptable quality. The map adequacy check form indicated only one deviation from the norm on one unit checked. Comments on the form indicate that other delineations contained small areas with 1 or 2 deviations, but were considered to be allowable inclusions and were not listed as deviations. Reviewer apparently only listed deviations where large enough to map separately.

Black Pond - Watershed No. 1A1037

The review of this watershed was conducted by on May 3, 1988. The report did not contain a map adequacy check list, therefore, there was no indication of the number of delineations examined. All appplicable questions on the report form were answered.

The report did not indicate that any issues of protocol, correlation, mapping, or transecting were brought up during the review. Section 2.2.2 of the report indicated map unit work sheets were complete and accurate for the watershed. The review report does not tell if mapping notes were available or checked. A check of transect notes indicated that map units were correct. Two soil components of mapping units were described in the watershed and found to be accurate and correct. The review report stated that no corrective actions were needed. In the comments Section 4.4 the reviewer noted that the crew was doing a "good job".

The report examined the mapping in accordance with the protocols except for the inclusion of a map adequacy check form. There was no indication of the number of delineations in the watershed or the number checked. Section 4.3 of the review report indicated that mapping was acceptable and the report adequately documented this.

Quiver Pond - Watershed No. 1A1019

The review of the watershed was conducted November 2, 1987. The report did not contain a map adequacy check form, therefore, there was no indication of the number of delineations examined. All applicable questions on the report form were answered. The report did not state that any issues of protocol, mapping, correlation, or transecting were brought up during the review.

Section 2.2.2 stated that map unit work sheets were complete and accurate for the watershed. Review report did not indicate if mapping notes were available or checked. Review of transect notes indicated that transect data did not always verify map unit. Two soil components of map units were described in the watershed and found to be adequate and correct. The review report indicated that no corrective actions were needed. In the comments, Section 4.4, the reviewer noted that the crew was doing a "good job".

The report examined the mapping in accordance with the protocols except for the inclusion of a map adequacy check form. There was no indication of the number of delineations in the watershed or the number checked. Section 4.3 of the report stated that mapping was acceptable and the report adequately documented this.

Stump Pond - Watershed No. IB3013

The review of the watershed was conducted on October 14, 1987. The map adequacy check form indicated that 13 delineations were checked. There was more than 1 stop on units 138A, 280E, 272B, and 281C. The delineation number was not recorded on the form; therefore, it could not be determined if the duplicates were more than 1 stop in 1 delineation. All applicable questions on the report form were answered. The report did not indicate that any issues of protocol, correlation, mapping, or transecting were brought up during the review.

It was stated in Section 2.1.10 that several units were new additions to the regional legend and that new map unit work sheets were required. The review report did not indicate if mapping notes were available or checked. Check of transect notes stated that transect data did not always verify map unit. Two soil components of map units were described in the watershed and found to be accurate and correct. The report indicated that no corrective actions were needed.

The report examined the mapping in accordance with the protocol; however, the report did not give the percentage of map delineations checked. The report indicated that all aspects of mapping were checked. No deviations from the norm were given for any of the units checked.

MAINE REPORTS

Hansen Pond - Watershed No. 1C3034

The review of the watershed was conducted on July 26, 1988. The map adequacy check form was for 3 traverses and documented on 3 sheets with 13 total stops. Four map units checked have duplicate numbers; therefore, it did not document that 13 different delineations were checked. All applicable questions on the report form were answered. The review report did not indicate that any issues of protocol, mapping, correlation, or transecting were brought up during the review.

Section 2.2.2 indicated that map unit work sheets were complete and accurate for the watershed. One new unit was added (later dropped and combined with unit 732A). Review did not indicate if mapping notes were available or checked. Check of transects stated that map units were correct. Eight soil components of map units were described in the watershed and found to be adequate and correct.

The only corrective action given was the re-evaluation of the new delineations and proposal of a new map unit. The corrective action was completed September 22, 1988. The review examined the mapping quality in accordance with the mapping protocols; however, the report did not give the percentage of map delineations checked. The report stated that all aspects of mapping were checked. The map adequacy check form was not used to show deviations from the norm; however, the reviewer indicated acceptability or lack of it in the comments column. The review report adequately documented that the mapping was of acceptable quality.

Ames Pond - Watershed No. ID2006

The review of the watershed was conducted on May 17 and 18, 1988. The map adequacy check form documented 3 traverses with 23 stops. Eight delineations checked had duplicate numbers; therefore, it did not document that 23 different delineations were checked. All applicable questions on the report form were answered.

Section 4.1 stated that map unit and transect data was to be evaluated and checked against the official series descriptions, and check description sites on transect lines. Section 2.2.3 indicated the transects were correct. Section 2.2.2 stated that map unit work sheets were complete and accurate for the watershed. This did not include the new units which were completed later (9/28/88). The review report did not tell if mapping notes were available or checked. Ten soil components of map units were described in the watershed and found to be correct.

The only deficiency noted was a requirement to check map unit descriptions and transect data against Official Series Descriptions and check location of sites on transect overlay. No corrective action was noted in conjunction with the deficiency. Section 4.4 stated that these items were checked prior to shipping the map products to US Environmental Protection Agency (USEPA).

The review examined the mapping quality in accordance with the mapping protocols; however, the report did not indicate the percentage of map delineations checked. The map adequacy check form was not used to show deviations from the norm; however, reviewer indicated acceptability or lack of in the comments column. The review report adequately documented that the mapping was of acceptable quality.

Upper Oxhead Pond - Watershed No. 1E1097

The review of the watershed was conducted on June 9, 1988 in conjunction with review by the RCC and Mapping Task Leader. The map adequacy check sheet indicated 10 delineations were checked. There were duplicate numbers; therefore, it did not document that 10 different delineations were checked. All applicable questions on the report form were answered. The review report did not indicate that any issues of protocol, mapping, correlation or transecting were brought up during the review. There were no additional field notes, soil descriptions or map unit descriptions attached to the report. Section 2.2.2 states that map unit descriptions were complete and accurate for the watershed with instructions to update for the new units. Section 4.1 indicated that more notes were needed to support mapping. Check of transect data indicated that map units were correct. Four soil components of map units were described in the watershed and all were correct except for Wonsqueak description which lacked needed reaction data. Deficiencies were noted for: (1) lack of field notes, (2) insufficient use of wet spot symbols, (3) insufficient reaction data to classify organic soil, and (4) locate description sites on transect overlay. Corrective action required was to resolve those items listed in Section 4.1. The corrective actions were completed September 6, 1988.

The review examined the mapping quality in accordance with the mapping protocols. The report indicated that all aspects of mapping were checked. The map adequacy check form was not used to show deviations from the norm; however, the reviewer provided comments at each stop. The review report adequately documented that the mapping was of acceptable quality.

PENNSYLVANIA REPORTS

Lake John - Watershed No. 1B1006

The review of the watershed was conducted on May 6, 1988. The report did not include a map adequacy check list; therefore, there was no indication of the number of delineations examined; however, the cover letter stated that one delineation of each mapping unit was traversed. All applicable questions on the report form were answered. The report does not indicate that any issues of protocol, correlation, mapping or transecting were brought up during the review. The report did indicate a problem with mapping in that areas ≥ 6 acres of differing slope were not delineated in a few instances.

Section 2.2.2 of the report indicated map unit work sheets were complete and accurate for the watershed. Review did not state if mapping notes were available or checked. Check of transect notes indicated that map units were correct. One soil component of map unit was described in the watershed and found to be adequate and correct.

The only corrective action specified was the delineation of a few excessively large slope inclusions. The corrections were made at the review. The report examined the mapping in accordance with the protocols except for the inclusion of a map adequacy check form. There was no indication of the number or delineations in the watershed or the percentage checked.

Section 4.3 of the report stated that the mapping was acceptable and this determination was adequately documented in the report. The reviewer's cover letter was an excellent addition to the report in that it was used to give the overall impressions of the mapping job.

Mud Pond - Watershed No. 1B2059

The review of the watershed was conducted on October 14 and 15, 1987 and completed in the office on February 11, 1988. The report did not include a map adequacy check list; therefore, there was no indication of the number of delineations examined. It was stated in Section 4.4 that 75 percent of the delineations were examined. All applicable questions on the report were answered.

The report did not indicate that any issues of protocol, correlation, mapping or transecting were brought up during the review. The report did indicate a minor problem with fitting some map units with landscape positions. Section 2.2.2 indicated that map unit work sheets were complete and accurate for the watershed except for one new unit added for this watershed. This had been discussed with the Mapping Task Leader and was to be provided later. The reviewer stated in Section 4.4 that field notes were available at the office part of the review. Check of transect data indicated that map units were correct. No soil components of map units were described in this watershed.

The only corrective actions addressed the question of fitting some map units to landscape positions. Corrective actions were completed during the field review (Oct. 15, 1987) with no further actions required. The review examined the mapping in accordance with the protocols except for the inclusion of a map adequacy check form. Section 4.3 stated that mapping was acceptable and this determination was adequately documented in the report.

2 INITIAL REGIONAL CORRELATOR/COORDINATOR (RCC) FIELD VISITS PROJECT

The initial field visits by the RCC were conducted during the fall of 1987. The primary purpose of the field visits was to provide training on the revised protocols and to accompany mapping crews into the field to a watershed that was currently being mapped or one that had mapping completed. Selection of the watershed was left to the individual state SCS representatives.

SCS personnel involved in the NE had worked on the original Northeast Region (NE) Direct/Delayed Response Project (DDRP) work in 1985; therefore, detailed training in the use of the protocols and preparation of final products was not deemed necessary. Basically, the training consisted of reviewing protocol changes that were made for the 1988 mapping. The most significant changes in the protocols that were covered in both office discussions and in the field were: (1) planning for and making required transects, (2) preparing forest cover and landuse maps, and (3) obtaining required pedon descriptions as documentation for soils mapped.

The approach to selecting and running line transects and recording the findings on the transect data sheets was better received and understood. The approach was found to be more acceptable by all involved than in 1985.

The primary issue regarding landuse was the use of some symbols that were not actually landuse, such as wetlands. Other concerns involved the lack of more precise definitions for the various landuse classes. Also numerous questions were brought up on handling idle areas that did not have sufficient tree cover to qualify as a forest.

Initially there was some misconception of how much detail was needed on pedon description and the amount of time required to prepare the descriptions. The concept of obtaining required pedon descriptions at transect stops was well received and appears to have fulfilled the requirements with a minimum expenditure of time.

PENNSYLVANIA

Field visit was made to Mud Pond, Watershed No. 1B2059 on October 13, 1987. Soil maps and cover type/landuse maps were complete but other maps and overlays had not been completed.

The transects had been selected but none had been conducted. Prior to going to the field, a short discussion of new protocols was held. The discussion was kept to a minimum as one of the soil scientists had attended the Mid-Appalachian training session held September 30 and October 1, 1987, in Parsons, WV. Representatives from USEPA had conducted a comprehensive training session for representatives from PA and WV. Mapping protocols were essentially the same for mapping during 1987-1988 in both the NE and Mid-Appalachian regions.

The field check consisted of a random traverse at the back of the golf course adjacent to the lake. Soils and cover type mapping was checked and found to be correct. During the afternoon the review team made a short transect across an area of Wellsboro soils. All observations indicated the area should have been mapped Lackawanna. Checked 2 areas mapped Norwich. Both were mapped too broadly and review party felt the areas were mostly Morris with some Wellsboro inclusions. The small areas of Norwich in the 2 locations could have been symbolized with a wet-spot symbol. The SCS conducted a field review on this watershed Oct. 14 and 15, 1987, and indicated these areas as deficiencies. Corrections were made during the field review. None of the other mapping team members in PA participated in this field visit.

NEW YORK

Field visit made to Stump Pond, watershed no. 1B3013 and Holp Pond, watershed no. 1B3068 on October 14 and 15, 1987. On Stump Pond the first draft of the soil map and cover type map was complete. Transect map and transects were complete. The state had not received mylar overlay material; therefore, none of the overlays were prepared. The visit was reported the SCS as a progress field review of Stump Pond. Map units 281C, 280E, 272B, 272C, 271B and 138A were field checked by random traverse and found to be correctly mapped. The only discrepancy noted was use of a wetland symbol R with E and F landuse classes. A record was not made of the total number of map delineations on Stump Pond; however, the 13 delineations checked exceeded 25 percent of the map delineations. The remainder of the day was devoted to selecting and running a 300 m transect on Holp Pond.

October 15, 1987 was devoted to transecting areas on Holp Pond and comparing DDRP mapping on the watershed with recently published soil survey of Sullivan County, NY. Since the published survey was very recent, only a few changes were required on the map except to apply the DDRP mapping legend. The transecting provided an excellent opportunity to provide training in this aspect of mapping and test the new procedures for transecting.

The only discrepancy was a minor error on watershed boundary of Holp Pond. This error was the same as the original USEPA watershed outline map. Contour lines on the map did not show sufficient detail of drainage pattern to determine the watershed boundary. Due to road culverts, a small area originally shown as being part of the watershed actually drained into another watershed. The deficiency was corrected in the field.

MAINE

Field visit to the state of Maine was conducted on Oct. 19 and 20, 1987. The entire day of October 19 was devoted to an in-office review of mapping protocols with the above personnel. Questions arising from this session were answered or referred to the Mapping Task Leader. The entire group participated in the bi-weekly teleconference with personnel from USEPA. Questions referred to the Mapping Task Leader were covered in a letter covering items discussed on the teleconference.

October 20 was devoted to a field trip to Bracey Pond, watershed no. 1E1060. Soil and cover type/landuse maps were the only map products completed on this watershed. Primary questions raised by mapping team leader involved cover type mapping on marsh areas where tree cover is frequently very sparse or existing cover is not a recognized cover type. The reviewer instructed mapper to fit to nearest possible recognized cover type. Also questions were raised regarding mapping in areas covered by water due to beaver dams. Instructed mapper to include beaver impoundments in soil delineations and show water as intermittent pond on drainage overlay.

The watershed boundary was changed from that shown on the USEPA map. A road across the watershed had effectively diverted a large part of the watershed drainage out of Bracey Pond.

The changes had been correctly handled. To provide training, a short transect was run on an area of Skerry soil. All personnel in Maine involved in the DDRP mapping attended the training session.

3 RCC FIELD REVIEWS

Two formal field reviews were made in the NE region. One was on Black Pond, watershed no. 1A1037 in St. Lawrence Co., NY; the other was for Upper Oxhead Pond, watershed no. 1E1097 in Washington Co., ME. A formal field review was not made on a watershed on the NE project in PA. Copies of the field review report forms were sent to the Mapping Task Leader in July 1988.

BLACK POND, NY

A field review was made June 7, 1988 on Black Pd., NY with a SCS State Office Representative. Notes made during the review are as follows:

Site 1. Mapped 22D-2 on south side of lake. The area was appropriately mapped.

Site 2. Same unit as site 1 except in an intermittent drainageway. This part of the delineation was also appropriately mapped.

Site 3. Observed area of Berkshire C slope in a mapping unit of Berkshire D slope. The area of C slope was less than 6 acres and was correctly mapped.

Site 4. Inclusion of a narrow area of F slope Berkshire in an area mapped as D slope Berkshire. Steeper slopes shown by short-steep slope symbol. Also soil at this site had loamy fine sand C horizon and was outside range of Berkshire series. Marginal to Monadnock soils.

Site 5. Checked area mapped as Loxley muck, unit 103A. The area was correctly mapped. It was felt that there was a mappable area of open land-wet that should have been shown on the landuse map. The area had been included with forest landuse.

Site 6. Checked area mapped 22B, Berkshire. The area was correctly mapped. The topography in the area was quite irregular and the area of 22B included a few small areas of 22C.

Site 7. Observed area of E slope Berkshire in area mapped 22D. The steeper area was marginal in extent to 6 acres and could have been mapped separately or shown with short-steep slope symbols.

Site 8. Observed 2 areas of cover type 33 that were less than 6 acres and should be deleted and combined with adjacent cover types.

There were no intermittent drains or streams shown on the map; however, there were low areas over which water would flow during extremely heavy rains or very rapid snow melt. After some discussion the review party concluded that the drainage overlay was correct as done. There had not been sufficient over land flow to make any kind of scar or channel mark in the leaves. There were no deficiencies noted or corrective actions required in this watershed. The mapping was judged to be acceptable.

My only comments were to use more conventional symbols to show short-steep slopes and the deletion of 2 small (< 6 acres) areas of forest cover type 33. These changes were made on the final map prior to submission to the USEPA. Also suggested keeping more detailed field notes on mapping in addition to transect notes and pedon descriptions.

UPPER OXHEAD POND, ME

A formal field review was made June 9, 1988 of mapping on Upper Oxhead Pd., ME. Both mappers accompanied the review team. Also participating in the review was the Mapping Task Leader.

Notes made during the review were as follows:

Site 1. The site was to assess stone cover on the mapped area and to approve the addition of a new unit to the legend, Becket fine sandy loam, 3 to 8 percent slopes, bouldery. The area was estimated to have a 40 percent stone cover and was approved for addition to the legend. Also the mapping team leader wanted the opinion of the review team as to the correct cover type for the area. The area had been clear cut and only a very few tree seedlings were growing. The smaller seedlings were spruce while the larger were paper birch. The cover type had been correctly mapped as paper birch. Some discussion followed on showing clear cut areas as pasture in some cases where tree cover is <10 percent. The review team recommended giving a cover type if at all possible in such a situation.

Site 2. Checked site mapped 20B-1, Becket. The Cd horizon was marginal to Marlow in texture but was left as Becket due to nature of landscape. Changed area of 20B to 368B, the bouldery equivalent of 20B.

Site 3. Checked area similar to that at site 2. Same disposition of mapping.

Site 4. Checked area similar to that at site 2. The Cd was slightly less dense. Slope was 13 percent. Symbolized as 368C.

Site 5. Observed very narrow area of Wonsqueak muck in area mapped 368C. The area of muck was a very narrow border, about 35m, along part of the lake. The area was too narrow to map but should have been shown with a wet-spot symbol and noted in mapping notes.

Site 6. Checked area mapped 20C. The area was correctly mapped. The Cd texture was marginal to Marlow. Slope was 12 percent.

Site 7. Checked area mapped as Wonsqueak muck. The organic material was 43 inches thick over mineral soil. The area was correctly mapped.

Site 8. Checked are mapped Berkshire fine sandy loam. The area was correctly mapped; however, the C horizon was gravelly loamy sand and the soil was marginal to Monadnock but not in a contrasting particle-size.

Site 9. Checked area mapped Berkshire, 22E. The area was correct as mapped but included D slope at the top of the unit and F slope on the lower part.

Site 10. Checked area mapped Monadnock, 122D. The soil has a 16" fine sandy loam mantle over a very gravelly loamy sand C horizon. This was a good example of Monadnock. Slope was 18 percent. Cover type was correctly shown as red pine.

The only deficiencies noted were use of wet-spot symbols on the drainage overlay to show narrow area of muck along shore of lake. More detail on soil pedon descriptions was needed to insure that they can be correctly classified. Examples of the latter were, Wonsqueak description cannot be classified due to lack of reaction data. Consistence in the C horizon was not given in the Becket and Berkshire descriptions. This was not essential to classification; however, the information was useful in distinguishing these from similar soils. The above deficiencies were corrected after the review. It was recommended that more notes be recorded to support mappers correlation decisions during mapping and that transects be run completely across delineations where reasonable to do so. The latter recommendation was based on the narrow strip of Wonsqueak muck included in Becket soils. The transect did not indicate any occurrence of Wonsqueak in Becket. The mapping in the watershed was acceptable. The only corrective action needed that was not made during the review was to return to the watershed to check reaction in the Wonsqueak soil.

4 INDEPENDENT EVALUATION OF WATERSHED MAPPING

QUALITATIVE EVALUATION

Twenty percent of the watersheds in the NE region were selected by USEPA personnel for the RCC independent evaluation of watershed mapping. They were selected by the Mapping Task Leader to insure that at least one watershed was evaluated for each mapping crew. This represented 9 watersheds distributed as follows: 3 in NY, 2 in PA, 2 in MA, I in ME, and I in NH. SCS personnel in ME. were responsible for mapping the watersheds in MA and NH.

Each SCS state office provided the RCC with materials needed for map evaluation. These materials consisted of the following:

- black and white, and color infrared (CIR) photographs providing stereoscopic coverage of the watershed,
- two paper copies of the soil map with legend,
- two transparent copies of the soil map,
- two paper copies of the landuse and cover type map with legend,
- two transparent copies of the landuse and cover type map, and
- in some but not all, copies of the transect data sheets and field notes were also provided.

The USEPA provided the RCC with copies of US Geological Survey (USGS) topographic maps with the watershed boundaries outlined. These maps also served as a locator map to aid in locating the watershed.

The USEPA selected the mapping units to be transected in conjunction with watershed map evaluation. The transecting was to be done on 60 mapping units in the region, and due to the time required to make the transects, it was necessary to make the transecting part of the qualitative evaluation. Due to this, part of the map delineations were preselected for checking; however, specific map delineations were randomly selected by the RCC. Other areas traversed by the RCC were those crossed while going to or coming from transected areas or by random traverse across portions of the watershed. The random traverses were selected by the RCC to permit checking as many different delineations as possible on a variety of landscapes. The goal in the qualitative evaluation was to evaluate 20 to 50 percent of the map delineations.

Landuse and forest cover type maps were field checked while checking soil mapping. Also vegetative cover was noted on transect data sheets. Depth-to-bedrock maps were not checked as part of the soil map evaluation as they were a direct reflection of the soil survey map. Depth classes I and II and in some cases class III can be taken directly from the soils that were mapped. Depth classes IV through VI can be inferred from the mapped soils but cannot be readily checked in the field unless there are numerous road cuts or other man-made excavations.

In making the map evaluation, the first step was to randomly select the map delineations of the map units that were assigned by USEPA for transecting. The transect lines were drawn on a paper copy of the soil map using a stereoscope with the photos to select a direction that crossed the delineation on a line perpendicular to the drainage where appropriate. Zig-zag patterns were used on very narrow delineations.

The next step was to stereoscopically draw the watershed boundary on the aerial photos. This provided an opportunity to check the accuracy of the watershed boundary. The watershed boundary on the photos was also used to orient a copy of the transparent soils and landuse maps to the aerial photos. Careful photo interpretation using a stereoscope helped to assess how well soil map delineation boundaries matched the observable landscape features. Also photo interpretation was used to identify any areas on which the mapping appeared questionable.

Photo interpretation of the CIR photos was particularly useful in making preliminary checks of the landuse and cover type maps. Generally speaking, the landuse and cover type maps were found to be quite accurate and this accuracy was thought to be a direct reflection of the recently flown aerial photographs. The transparent soil map was used with both the aerial photos and copies of the USGS topoquads in evaluating soil mapping. The soils overlay copies were strictly line maps; therefore, overlaying on the aerial photo and topo maps was necessary to relate map unit boundaries to identifiable reference points on the ground. In most cases the overlays fit the aerial photo quite well although there were the usual scale limitations of unrectified photography. In some cases the flight line for the watershed was not in a straight line and stereo interpretation was more difficult. After the above steps, the remainder of the evaluation was done as a field check of mapping in the assigned watershed.

Following is a list of watersheds that USEPA assigned for field evaluation:

1) Triangle Lake, NY, Watershed no. 1B3003,
2) Huckleberry Lake, NY, Watershed no. 1A2056,
3) Twin Ponds, East, NY, Watershed no. 1A2001,
4) Goose Pond, PA, Watershed no. 1B1038,
5) Boyle Pond, PA, Watershed no. 1B2069,
6) No Name Lake, MA, Watershed no. 1D10ll,
7) Cusky Pond, MA, Watershed no. 1D2087,
8) Bracey Pond, ME, Watershed no. 1E1060, and
9) Shaws Pond, NH, Watershed No. 1C1046,

SUMMARY OF WATERSHED EVALUATIONS

Map unit composition of transected units is discussed in the following section on quantitative evaluation.

Triangle Lake, NY

The mapping was evaluated June 24, 1988. The RCC checked 6 of 10 map delineations for 60 percent check. Line transects were made on 6 map delineations. The soil and landuse maps were found to be acceptable with the following revisions on the soil map: 1) Separate area of Oquaga-Arnot complex from area mapped 96C-2. This change involves 12 acres. 2) Revise area of 257A-1 along creek that better matches Udifluvaquents-Fluvaquents complex. This change involves 11 acres. Where checked, the Arnot soils were not skeletal but they would be in the same sample class; therefore, no change was suggested.

There was some question regarding the dominance of tree species in cover type 108, red maple. In some areas sugar maple was thought to dominate but after discussion with the soil scientists I decided to leave as red maple rather than changing to cover type 27. Except as noted above, the map delineations and map unit composition were acceptable. Map unit boundaries were accurately located on other units.

Huckleberry Lake, NY

The mapping was evaluated July 6, 1988. Checked 8 of 11 map delineations for 72 percent check. Line transects were made on 3 map delineations.

The soil and landuse maps were found to be accurate and acceptable. Map unit boundaries were accurately located on all units checked. There were no suggestions for any needed corrections. Where transected, unit 214C-3 was dominated by Berkshire soils rather than Tunbridge; however, this difference did not affect the quality of the map unit; unit 214C-2, where transected, had a small mappable area of 215C that should have been mapped out. The remaining area of 214C-2 appears to be correctly mapped.

Twin Ponds, East, NY

The mapping for this watershed was evaluated July 13 and 14, 1988. I checked 14 map delineations out of 18 for 77 percent check. Line transects were run on 8 map delineations.

The soil maps were found to be accurate and acceptable with the following revisions: 1) Units of 21C should be redesignated 20C. Three delineations, 21C-1, 21C-2, and 21C-3 were checked and appear to have less than 5 to 10 percent Lyman soils. Most shallower areas are likely Tunbridge which is an allowable inclusion in 20C; 2) Unit 21E-2 should be remapped as 20D. Transect indicated no occurrence of Lyman soil; 3) Unit 103A-1 should be remapped 30A. The organic soils in the unit are variable with respect to depth of organic layers and texture of the 2C horizon. Observations other than along transect indicated that stream deposition and deposits in old beaver dams were better classified as Fluvaquents. The above changes involved 164 acres of 21C, 9 acres of 103A-1 and 25 acres of 21E. The change on 21C was not as drastic as it appeared, unit 21C is 50 percent Becket and unit 20C is 70 percent Becket. Needed changes were to be made and submitted to SCS state office. Map unit boundaries were accurately located. Except as noted above, the map delineations and map unit composition were acceptable. Landuse and cover type map was accurate and acceptable.

Goose Pond, PA

The mapping was evaluated June 28 and 29, 1988. Mapping party accompanied RCC on the evaluation. I checked 25 map delineations of 35 for 71 percent check. Line transects were run on 14 map delineations.

The soil and landuse/cover type maps were found to be accurate and acceptable. Noted an area of 602C-2 that contained two small mappable areas of 142C involving about 6 acres each. Unit 129B-2 which was transected was dominantly Wellsboro soils. The area was only 4 acres and should have been shown with a wet-spot symbol. Units 141B-1 and 141B-2 were transected and, where transected, were a better match for unit 142B; however, the total area appears to be correctly mapped. Unit 129B-1 contained 15 to 50 percent boulder cover over the entire area. There is not a bouldery unit of Morris in the legend and the area was retained as mapped.

Other map delineations checked were as described in map unit descriptions and map unit boundaries were accurately located. Except as noted above, there were no suggestions for changes that might be made on the maps.

Boyle Pond, PA

The watershed mapping was evaluated June 30, 1988. The mapping party accompanied RCC on the evaluation. I checked 12 of 14 map delineations for an 85 percent check. Line transects were made on 5 delineations.

The soil and landuse/cover maps were found to be accurate and acceptable. Part of units 141D-1, 141D-2, and 141E-1 were bouldery with 141D-2 and 141E-2 containing about 5 percent rock outcrop. There were no bouldery or stony units of the above series and due to limited extent, addition of boulder units for these series was not warranted. The cover type on unit 129B-1 should have been shown as red maple. The other map delineations checked were as described in the map unit descriptions and map delineation boundaries were accurately located. Except as noted above, there were no suggestions for needed corrections.

No Name Lake, MA

The mapping for this watershed wasd evaluated July 18 and 20, 1988. I checked 33 of 89 delineations for 37 percent check. Line transects were run on 7 delineations. The soil maps were found to be accurate and of acceptable quality. Only one delineation, 22C-9 included a mappable area of dissimilar soils. This was a mappable area of 359A, Wonsqueak muck, also the area was dominated by 3-8 percent slopes and should have been mapped as 22B. Other map delineations checked were as described in the map unit descriptions.

The landuse/cover type map was accurate and acceptable except one area of 108, red maple was mislabeled as red oak. This was corrected. Open land along highway at south end of lake was labeled pasture. The area was mostly native grass that had been cut for hay but was not used for intertilled crops. Due to this fact the area was retained as pasture. There were no other recommendations for needed corrections.

Cusky Pond, MA

The mapping was evaluated July 22 and 23, 1988. I checked 16 of 31 map delineations for 51 percent check. Line transects were made on 5 map delineations.

The soil map was found to be accurate and of acceptable quality. Map unit boundaries were accurately located on all units checked except unit 144A-1. The narrow part of the delineation extending westerly to Cusky Pd. was mineral soil dominated by Woodbridge soil with small inclusions of Ridgebury. The area was 8 acres and should have been mapped out. The mapper used a spot symbol (#) to indicate a till spot in the area. Three units, 263B-1, 262C-2 and 262B-2 were <6 acres and should be deleted.

The landuse/cover type map was accurate for most of the watershed; however, the following recommendations were made for corrections to the map. Area mapped pasture on the east of the watershed (Klem's farm) was, in part, mismapped.' It should have been cropland as part was in corn and part was in rotation hay. An area classified as forest land not grazed (about 8 acres) should have been classified as forest land grazed. A map with suggested changes was provided to the SCS state office for use in correcting the map. Except as noted above, there were no other suggestions for corrections.

Bracey Pond, ME

The mapping was evaluated July 26 and 27, 1988. I checked 10 of 15 delineations for 66 percent check. Line transects were run on 5 map delineations.

The soil map was found to be accurate and of acceptable quality. The area of 187B-1 was small (2 acres) and was dominated by till. Map later changed to include 187B-1 with adjoining area of Wonsqueak muck. A part of 20C-3 on south end of delineation was Colton and could have been mapped with an adjoining unit of 54C-1. The change would have involved about 2 or 3 acres. The landuse/cover type map was accurate and acceptable as mapped. Except as noted above, there were no other suggestions for corrections.

Shaw's Pond, NH

Evaluated July 29 and 30, 1988. I checked 17 of 34 delineations for 50 percent check. Line transects were run on 8 delineations. The soil map was found to be accurate and of acceptable quality. Two units checked, 370E-4 and 372E-3 contained 5 to 10 percent inclusions of exposed bedrock. Areas of 122C and 122D (Monadnock) included small areas of Becket soils scattered throughout the units. The landuse and cover type map was found to be accurate and of acceptable quality. There were no suggestions for corrections.

QUANTITATIVE EVALUATION

The map units to be transected were selected by USEPA. Specific map delineations of the selected map units were randomly selected by the RCC.

Sixty one (61) transects were run as follows:

Map Unit	Number of Transects
11C	1
20C	4
20D	4
21E	3
22C	3
96B	4
96C	1
96D	1
103A	4
122D	3
129B	4
141B	3
141D	3
144A	4
192B	4
214C	4
229B	2
229C	4
236C	3
359A	4

Triangle Lake, NY

Transect #1, unit 96B-1. The transect started in an abandoned camp; therefore, 2 pedons were classified as Udorthents where construction had altered the soil. Six sites were considered to be taxadjuncts of Lackawanna due to color in the Bx horizon. One site was Lackawanna, one was Morris. Due to the dominance of the taxadjuncts, the area was not a good fit for the map unit description but was acceptable as mapped.

Transect #2, unit 96D-1. Site 1 was at the edge of the lake and was Morris. The other 9 sites were Lackawanna. The area is a good match for the map unit description (MUD).

Transect #3, unit 96C-2. The transect was run in 2 segments. Pedons 1-4 in one and 5-8 in the other. A originally mapped, the first 4 in the transect and the first 6 in transect 4 were in a unit of 96C. Based on my observations, the map was corrected in this area. As originally mapped, the area was not a good match for the MUD; however after map revision the match was acceptable.

Transect #4, unit 141B-2. The first 6 sites in the transect were in an area originally mapped 96C. The mapping was revised and the transect was in an area that was mapped 141B-1 after revisions were made. The area is 1/2 Arnot and 1/2 moderately deep Oquaga and Lordstown. Based on this data, the area is a little better match for unit 142B even though Arnot dominates. The Arnot soils in the unit are not skeletal and are taxadjuncts to the Arnot series.

Transect #5, unit 229C-1. Eight sites on this transect. Seven sites are Wellsboro and 1 is Arnot. The area is a good fit for the (MUD) even though Arnot is not listed as an inclusion.

Transect #6, unit 11C-1. Eight sites were Arnot taxadjunct, 2 were Lordstown. The Arnot soil is not skeletal and considered a taxadjunct. Unit 11C was dropped from the legend due to low acreage and combined with unit 142C. The area was an acceptable match although no Oquaga soils were observed on the transect.

Huckleberry Lake, NY

Transect #1, unit 214C-1. Six pedons were Berkshire, 2 were Tunbridge, 1 was Colton and 1 was Sunapee. The area was dominated by Berkshire but was better mapped 214 rather than 22C to recognize the moderately deep component. The area was an acceptable match with the MUD.

Transect #2, unit 103A-1. Seven pedons were Loxley and 3 were Beseman. At correlation the unit was renamed Loxley-Beseman complex. It is a very close match for the MUD.

Transect #3, unit 214C-2. Where run, the transect was dominated by very shallow, shallow, and moderately deep soils and rock outcrop. The area transected is a better match with unit 215C, Tunbridge-Lyman complex, which permits both rock outcrop and very shallow soils.

Twin Ponds, East, NY

Transect #1, unit 103A-1. The area was indicated as being dominated by Beseman; however, the 2C horizon was variable with respect to texture. Due to variability, the area was thought to better match unit 30A. The map was changed to accommodate this recommended change.

Transect #2, unit 21E-1. Five pedons were Becket and five were Tunbridge. Unit 21E was renamed Becket-Tunbridge-Lyman complex at correlation. Even though no Lyman soils were observed, the area is an acceptable match for the new unit 285E.

Transect #3, unit 21E-2. All 10 pedons were Becket and the map was changed to 20D. Five sites were D slope and five were E slope. There is no unit 20E in the legend. The area is a good match for 20D MUD.

Transect #4, unit 192B-2. Four pedons were Skerry, 3 were Becket, 2 were Lyme and Pillsbury and 1 was Beseman. The area contained < 75 percent Skerry but was correctly mapped and an acceptable match with the MUD.

Transect #5, unit 103A-3. The area was quite small (about 3 acres) and much was covered with water so only 8 sites were on the transect. All sites were near edge of delineation and dominated by shallow muck. Deeper muck likely dominates near the center of the delineation which was inundated. The area was an acceptable match for map unit 103A as revised at correlation.

Transect #6, unit 21E-2. Three pedons were Tunbridge, 2 were Lyman, 4 were very shallow soils and 1 was Becket. Based on this transect the area of the transect better matches map unit 215E.

Transect #7, unit 192B-1. Nine pedons were Skerry and 1 was Pillsbury. The area was an acceptable match for the MUD.

Transect #8, unit 103A-3. Nine pedons were considered to be Loxley even though pedon #2 was fibric to 26". One pedon was Beseman. The area was an acceptable match for the MUD.

Goose Pond, PA

Transect #1, Unit 144A-2. Eight pedons were Palms muck, 2 pedons were Carlisle muck. The content of Carlisle was a little higher than described in the MUD but was an acceptable match.

Transect #2, Unit 141B-1. Four pedons were Oquaga, 4 pedons were Arnot, 1 was Lithic Udorthent and 1 was rock outcrop. Based on this transect, the area better matches unit 142B.

Transect #3, unit 141B-2. Six pedons were Oquaga, 3 were Arnot, 1 was Lithic Udorthent. Based on this transect, the area better matches map unit 142B.

Transect #4, unit 96B-7. Ten pedons were Lackawanna. The area fit well within the limits of the MUD.

Transect #5, unit 129B-2. Three pedons were Morris taxadjunct, 7 were Wellsboro taxadjunct and questionable Wellsboro. The area was only 4 acres and should have been included with adjoining Lackawanna and shown with a wet-spot symbol.

Transect #6, unit 229B-2. Eight pedons were Wellsboro and 2 were Morris. The area is an acceptable match for the MUD.

Transect #7, unit 229B-3. Ten pedons were Wellsboro. The area is a good match for the MUD.

Transect #8, unit 129B-3. Eight pedons were Morris or Morris taxadjunct and 2 were Wellsboro. The area is an acceptable match for the MUD.

Transect #9, unit 229C-1. Six pedons were Wellsboro, 3 were Lackawanna and 1 was Morris. The area is an acceptable match for the MUD even though Lackawanna soils exceed the specified limit.

Transect #10, unit 96B-2. Nine pedons were Lackawanna and 1 was Wellsboro. The area is a good match for the MUD.

Transect #11, unit 129B-1. Seven pedons were Morris or Morris taxadjunct and 3 were Wellsboro or Wellsboro taxadjunct. The area matched the concepts of the MUD although it was bouldery. There is no bouldery unit of Morris in the legend.

Transect #12, unit 96B-4. Ten pedons were Lackawanna. The area is a good match for the MUD.

Transect #13, unit 229C-2. Six pedons were Wellsboro, 4 were Lackawanna. The area transected contained more pedons of Lackawanna than described in the MUD but is considered an acceptable match.

Transect #14, unit 144A-1. Seven pedons were Palms and 3 were Carlisle. The Carlisle occurrence is greater than that in the MUD, but the area is an acceptable match.

Boyle Pond, PA

Transect #1, unit 229C-1. Six pedons were Wellsboro, 2 were Lackawanna, 1 was Morris and 1 was a Fluvaquent. The area contained slightly more Lackawanna than described but is an acceptable match for the MUD.

Transect #2, unit 141D-1. Ten pedons were thought to be Oquaga. Stoniness made digging very difficult. The area had up to 50 percent stone cover but there is no stony unit of Oquaga in the legend. As such, the area is an acceptable match for the MUD.

Transect #3, unit 141D-2. Seven pedons were Oquaga, 1 was Oquaga taxadjunct, 1 was Arnot and 1 was rock outcrop. The area is an acceptable match for MUD.

Transect #4, unit 141D-3. Nine pedons were Oquaga or Oquaga taxadjunct (non skeletal), 1 was Arnot. The area is an acceptable match for the MUD.

Transect #5, unit 129B-1. Six pedons were Morris or Morris taxadjunct, 2 were Wellsboro, 2 were Norwich taxadjunct. The area is an acceptable match for the MUD.

No Name Lake, MA

Transect #1, unit 22C-9. Nine pedons were Berkshire and 1 was Sunapee. Nine pedons were B slope. The area should have been mapped 22B.

Transect #2, unit 359A-7. Nine pedons were Wonsqueak muck and 1 was Bucksport muck. The area is an acceptable match for the MUD.

Transect #3, unit 22C-14. Nine pedons were Berkshire and 1 was Lyman. The area is an acceptable match for the MUD.

Transect #4, unit 359A-4. Six pedons were Wonsqueak, 2 were thought to be Lyme and 2 were Aquepts (like Whitman but frigid) with organic surface just under 16". The transect was around edge of unit due to water over the surface in center where muck > 16" is more likely to occur. The area is an acceptable match for the MUD.

Transect #5, unit 214C-3. Seven pedons were Berkshire, 2 were Tunbridge and 1 was rock outcrop. Berkshire dominates in line of transect; however, the 214 map unit is the best match for the area.

Transect #6, unit 22C-6. Six pedons were Berkshire, 1 was Sunapee, 2 were Peru and 1 was Lyman. The area is an acceptable match for the MUD.

Transect #7, unit 214C-1. Six pedons were Tunbridge or Tunbridge taxadjunct, 2 were Berkshire and 2 were Lyman. The area is an acceptable match for the MUD.

Cusky Pond, MA

Transect #1, unit 236C-5. Eight pedons were Woodbridge and 2 were Paxton. The area is an acceptable match for the MUD even though the lower part of the unit is stony.

Transect #2, unit 236C-1. Nine pedons were Woodbridge and 1 was Charlton. The area is an acceptable match for the MUD.

Transect #3, unit 144A-1. Ten pedons were Palms. The area is an acceptable match for the MUD.

Transect #4, unit 236C-3. Ten pedons were Woodbridge. The area is an acceptable match for the MUD.

Transect #5, unit 144A-2. Five pedons were Palms, 2 were Aquepts (like Whitman but frigid) with organic surfaces 12 and 14 inches thick. Permission to transect entire area was denied by landowner and only a small part of the total area was investigated. The area is an acceptable match for the MUD.

Bracey Pond, ME

Transect #1, unit 192B-1. Five pedons were Skerry, 1 was Peru, 1 was Becket and 3 were Masardis. The area of outwash (Masardis) was small and shown by gravel spot symbol on the map. The area was appropriately mapped and an acceptable match for the MUD even though Masardis soils were not in the MUD.

Transect #2, unit 359A-1. Ten pedons were Wonsqueak. The area was an acceptable match for the MUD.

Transect #3, unit 20C-3. Six pedons were Becket, 2 were Marlow, and 2 were Pillsbury. The unit adjoined an area of muck and near the boundary the soils were wetter than described in the MUD. The area was an acceptable match for the MUD.

Transect #4, unit 192B-2. Eight pedons were Skerry, 1 was Peru, and 1 was Brayton. The area was bouldery, otherwise it was an acceptable match for the MUD. There was no bouldery unit of Skerry in the legend.

Transect #5, unit 20C-1. Eight pedons were Becket and 2 were Skerry. The area was an acceptable match for the MUD.

Shaw's Pond, NH

Transect #1, unit 20C-1. Ten pedons were Becket. The area was an acceptable match for the MUD.

Transect #2, unit 20D-1. Eight pedons were Becket and two were Tunbridge. The area was an acceptable match for the MUD.

Transect #3, unit 122D-6. Six pedons were Monadnock and 4 were Becket. The Becket pedons exceed that permitted in the map unit. Mapper had made notes on the inclusions of Becket in Monadnock. Within the constraints of the legend, the area was appropriately mapped.

Transect #4, unit 122D-1. Ten pedons were Monadnock. The area was an acceptable match for the MUD.

Transect #5, unit 359A-1. Ten pedons were Wonsqueak taxadjunct which has a sand 2C horizon. Except for the 2C horizon texture, the area was an acceptable match for the MUD.

Transect #6, unit 20C-2. Nine pedons were Becket, 1 was Skerry. The area was an acceptable match for the MUD.

Transect #7, unit 20D-2. Eight pedons were Becket, 2 were Skerry. The area was an acceptable match for the MUD.

Transect #8, unit 122D-3. Seven pedons were Monadnock and 3 were Becket. As in transect #3, Becket exceeded that permitted in the MUD. Within the constraints of the legend, the area was appropriately mapped.

GENERAL COMMENTS ON FINDINGS OF RCC TRANSECTS

The transects may not be the best indicator of mapping quality because there may not be a sufficient number of them to make valid inferences. Transects that cross map unit inclusions may yield unrealistic map unit composition. Mappers use their professional judgement to override the results of transects where the transects do not seem to be representative.

Of the 61 transects run, 42 were judged by the RCC to be an acceptable match for the map unit description; 11 were not a good match for the map unit description but were the best available match within the limits of the mapping legend; and 8 were not acceptable matches with the named map unit.

The 42 transects that are acceptable matches for the map unit description were not exact matches when considering only a single transect of 10 points. In this situation 2 pedon sites of an included soil will indicate an excessive occurrence of the inclusion but if many transects were made the percentage of dissimilar inclusions will average out and become a better match for the MUD. The 11 transects that were not a good match were the best match within the limits of the legend and were not thought to be serious discrepancies. Three were placed in this category because the soils were taxadjuncts to the named series, 3 were stony or bouldery areas of soils for which there was no stony or bouldery unit in the legend; 2 had 30 to 40 percent inclusions of a more slowly permeable soil but there was not a complex of the 2 soils in the legend; 2 were complexes in which the less dominant soil was found to be dominant and 1 was a small area (4 acres) of moderately well drained and somewhat poorly drained soils that was mapped as somewhat poorly drained. Because of small size, the area should be deleted and shown with a wet-spot symbol.

Of the 8 transects not making an acceptable match with the map unit description, 1 area that was mapped as a deep soil was found to have a mappable area of moderately deep and shallow soils; 1 was mapped as 214C, Tunbridge-Berkshire complex that included a mappable area of 215C; 1 area was mapped as a consociation of a muck soil (103A) which better matched a complex of muck and wet alluvium (30A); one area that was mapped as a complex of deep, shallow and moderately deep soils (21E) contained only deep soils and better matched 20D; one area mapped as 21E contained no deep soils and better matched unit 215E; two areas were mapped as moderately deep soils (141B) but where transected were found to be complexes of moderately deep and shallow soils (142B); and 1 area was mapped as C slope but 9 sites were B slope and the entire unit should have been mapped as a B slope. In each case designated as not acceptable, the map legend contains map units that are a better match for the area.

Comparison of composition and naming of map units from RCC transects was made with composition and naming as stated in the map unit description database. These comparisons were made only for units on which the RCC had 3 or 4 transects.

Unit Transected: 20C, Becket fine sandy loam, 8-15 percent slopes, 4 transects

Composition and Name

Composition Database	From RCC transects
70% Becket	72% Becket
5% Skerry	7% Skerry
5% Tunbridge	3% Duane
5% Monadnock	3% Pillsbury
5% Marlow	5% Marlow
5% Becket 3-8% slope	10% Becket 3-8
5% Berkshire	

Name based on RCC transect - Becket fine sandy loam, 8-15 percent slopes

Unit transected: 21E, Becket-Tunbridge Lyman complex, 15-45 percent slopes, 3 transects.

Composition and Name

Composition Database	RCC Transects
50% Becket	54% Becket
20% Tunbridge	27% Tunbridge
15% Lyman	6% Lyman
5% Abram	10% Abram (Scoodic)
5% Ricker	3% Ricker
5% Rock Outcrop	

Name based on RCC transects - Becket-Tunbridge complex, 15-45 percent slopes

Unit transected: 22C, Berkshire fine sandy loam, 8-15 percent slopes, 3 transects

Composition and Name	
Composition Database	RCC Transects
75% Berkshire	80% Berkshire
5% Sunapee	7% Sunapee
5% Hermon	
5% Marlow	
5% Peru	7% Peru
5% Tunbridge	6% Lyman

Name based on RCC transects - Berkshire fine sandy loam, 8-15 percent slopes

Unit Transected: 96B, Lackawanna channery loam, 3-8 percent slopes, 4 transects

Composition and Name	
Composition Database	RCC Transects
80% Lackawanna	90% Lackawanna
10% Oquaga	4% Udorthents
5% Wellsboro	3% Wellsboro
5% Swartswood	3% Morris

Name based on RCC transects - Lackawanna channery loam, 3-8 percent slopes

Unit Transected: 103A, Loxley-Beseman mucks, 0-3 percent slopes , 4 transects

Composition and Name	
Composition Database	RCC Transects
70% Loxley	43% Loxley
20% Beseman	50% Beseman
5% Fluvaquents	5% Fluvaquents
5% Wakish	

Name based on RCC transects - Beseman-Loxley mucks, 0-3 percent slopes
Sites transected were inundated near center of unit where Loxley would be expected to dominate

Unit Transected: 122D, Monadnock fine sandy loam, 15-25 percent slopes, 3 transects

Composition and Name

Composition Database	RCC Transects
70% Monadnock	80% Monadnock
19% Berkshire	20% Becket
5% Hermon	
5% Tunbridge	
5% Marlow	
5% Sunapee	

Name based on RCC transects - Monadnock-Becket complex, 15-25 percent slopes

Unit Transected: 129B, Morris loam, 3-8 percent slopes, 4 transects

Composition and Name

Composition Database	RCC Transects
70% Morris	60% Morris
15% Wellsboro	35% Wellsboro
10% Norwich	5% Norwich
5% Chippewa	

Name based on RCC transects - Morris-Wellsboro complex, 3-8 percent slopes

Unit Transected: 141B, Oquaga Channery Loam, 3-8 percent slopes, 3 transects

Composition and Name

Composition Database	RCC Transects
80% Oquaga	37% Oquaga
10% Arnot	37% Arnot
5% Lordstown	10% Lordstown
5% Lackawanna	3% Tuller
	10% Lithic Udorthents
	3% rock outcrop

Name based on RCC transects - Oquaga-Arnot complex, 3-8 percent slopes.

Unit Transected: 141D, Oquaga channery loam, 15-25 percent slopes, 3 transects

Composition and Name

Composition Database	RCC Transects
85% Oquaga	90% Oquaga
10% Lackawanna	7% Arnot
5% Lordstown	3% Rock outcrop

Name based on RCC transects - Oquaga channery silt loam, 8-25 percent slopes

Unit Transected: 144A, Palms muck, 0-3 percent slopes, 4 transects

Composition and Name

Composition Database	RCC Transects
90% Palms	81% Palms
5% Carlisle	14% Carlisle
5% Aquepts	5% Aquepts (Whitman)

Name based on RCC transects - Palms muck, 0-3% slopes

Unit Transected: 192B, Skerry fine sandy loam, 3-8 percent slopes, 4 transects

Composition and Name

Composition Database	RCC Transects
75% Skerry	63% Skerry
10% Brayton	3% Brayton
5% Becket	10% Becket
5% Berkshire	8% Masardis
5% Pillsbury	5% Pillsbury
	8% Peru
	1% Lyme
	2% Beseman

Name based on RCC transects - Skerry fine sandy loam, 3-8 percent slopes

Unit Transected: 214C, Tunbridge-Berkshire complex, 3-15 percent slopes, 4 transects

Composition and Name

Composition Database	RCC Transects
40% Tunbridge	35% Tunbridge
35% Berkshire	38% Berkshire
10% Lyman	8% Lyman
5% Monadnock	8% Rock outcrop
5% Sunapee	5% Schoodic
5% Peru	3% Ricker
	3% Sunapee

Name based on RCC transects - Berkshire-Tunbridge complex, 3-15 percent slopes.

Unit Transected: 229C, Wellsboro channery loam, 8-15 percent slopes, 4 transects

Composition and Name

Composition Database	RCC Transects
70% Wellsboro	63% Wellsboro
10% Lackawanna	28% Lackawanna
10% Morris	5% Morris
5% Oquaga	2% Arnot
5% Norwich	2% Fluvaquents

Name based on RCC transects - Wellsboro-Lackawanna complex, 8-15 percent slopes

Unit Transected: 236C, Woodbridge fine sandy loam, 8-15 percent slopes, 3 transects

Composition and Name

Composition Database	RCC Transects
70% Woodbridge	80% Woodbridge
10% Paxton	7% Paxton
5% Charlton	3% Charlton
5% Canton	
5% Ridgebury	
5% Sutton	

Name based on RCC transects - Woodbridge fine sandy loam, 8-15 percent slopes.

Unit Transected: 359A, Wonsqueak muck, 0-3 percent slopes, 4 transects

Composition and Name	
Composition Database	RCC Transects
70% Wonsqueak	88% Wonsqueak
10% Bucksport	3% Bucksport
10% Aquepts	5% Aquepts (Whitman fr.)
5% Searsport	4% Lyme

Name based on RCC transects - Wonsqueak muck, 0-3 percent slopes
The Wonsqueak in the unit included pedons that were taxadjuncts for 2C horizon texture

5 CONCLUSIONS

The initial RCC field visits in the fall of 1987 were very useful to make protocol updates with SCS personnel involved with the project. This was particularly true in light of the changes made in methodology of transecting and in preparation of landuse and cover type maps.

The only state that had all involved mappers at the initial RCC field visit was ME. They also set aside time to make a complete in-office review of the new mapping protocols. This procedure would have been more useful in PA and NY than just going out to a watershed with a single mapping team. The personnel in PA and NY were under the impression that the visit was to make a formal field review. Better communication was needed with SCS in the latter states prior to the visit. It was the general opinion of involved personnel that more training would have been helpful. The training would be more effective after each mapper has done some mapping and had an opportunity to test out the protocols.

The SCS progress field reviews that were reviewed by the RCC were complete and gave a good overview of the progress of the particular mapping team. The percentage of map units that were checked in the field were not adequately documented. Some used the map adequacy check form but did not give the total number of map delineations in completed watersheds, others did not use the check form at all. Where reviews were made prior to completion of mapping the extent checked as a percentage of total map delineations cannot be provided. In this case the reviewer can only list the review stops and the soils checked and the questions, if any, that were resolved at the review.

The field review report form was a good format for submitting the review report. It provided uniform and consistent reviews of various mapping teams and among the involved states. The RCC review of the state field review reports would have been more useful if done earlier in the mapping process.

The RCC made two formal progress field reviews. One was in NY, the other was in ME. A review was not made in the NE region in PA. The decision was made by the USEPA to conduct the PA review in the Mid-Appalachian region.

The primary comment arising from the RCC field reviews was the need for more detailed notes on the soils and mapping in each watershed. Notes help reviewers understand the mappers correlation decisions made during mapping.

The independent evaluation of nine watersheds in the region indicated that the mapping was of acceptable quality. Only 2 of the 9 watersheds needed minor revision of the soil maps. In one watershed these changes involved 23 acres in a watershed of 288 acres. The changes were made in the mapping prior to submission of the map products to the USEPA. In the other watershed the changes involved 198 acres in a watershed of about 540 acres. The major part of this change (164 acres) involved changing 3 map delineations from a complex to a consociation of the major soil named in the complex. The major soil comprised 50 percent of the complex and 70 percent of the consociation. Basically, the change only involved about 33 of the 164 acres. The SCS soil scientist who accompanied the RCC on the evaluation made needed changes on the final map.

The other seven watersheds contained only minor discrepancies or none at all. Such errors or discrepancies were thought to be within the normal error of observation and did not warrant map revision.

Generally, noted discrepancies involved relatively small areas and for the most part occurred as one of the following:

- soils were taxadjunct to named series,
- soils were stony or bouldery and a stony or bouldery unit of the soil was not in the legend,
- slope of area mismapped,
- few areas of non-hydric soils less than 6 acres,
- complexes where the dominance of the named soils was reversed,
- consociations where a second soil was sufficiently extensive to name as a complex, and
- a few 2 to 3 acre areas of hydric soils that were not mapped.

It should be noted that watersheds mapped and inked on the aerial photos prior to transferring to the soil overlay provided a soil map that was much easier to check in the field. In many cases it was difficult to orient the line soil map to the blank aerial photo.

The landuse/ cover type maps were generally very well done. Only minor discrepancies in cover type were noted and these usually involved the identification of major tree species such as red maple versus sugar maple or red spruce versus red spruce-balsam fir. In none of the watersheds checked were there mappable areas of conifers included with hardwoods or vice versa.
The accuracy of the cover type mapping is thought to be largely due to careful use of recently flown CIR photography. In reviewing the cover type maps it is necessary to keep in mind that the SAF cover types were intended for use on very broad regional areas, not areas as small as used in the watershed maps.

Problems involving land use were in most or all cases due to a lack of complete definitions of the various landuse classes. These problems were mainly noted on recently clear cut areas; idle cropland or pasture that was growing up in brush; swampy areas that did not have a tree cover but have a cover of brushy type vegetation. The other noted problem was rotation hayland that was currently being pastured. The area was mapped as pasture when the primary landuse was cropland.

Transects were run on 61 map delineations representing 20 different map units. Forty two were acceptable matches for the named map unit; 11 did not match map unit exactly but were the best match within the constraints of the map legend; and 8 were not an acceptable match for the named map unit. In the latter case only one area was mismapped with respect to sample class. The other 7 areas, where transected, were better match for other map units in the legend.

Of the map units with 3 or 4 transects, 8 would be named as in map unit description; 7 showed only minor differences such as component soils in a complex making up a little less than 15 percent or consociations with a second soil comprising > 15 percent; or reversed components of a complex.

Map units with 1 or 2 transects did not provide a sample with sufficient sites to permit judging the composition of the map unit. The line transects run during the quantitative evaluation were used in the qualitative evaluation of mapping. As such, they were used to assess only that part of the map unit that was actually covered by the transect. In some cases areas covered by the transect were large enough that a different unit could be recommended where the map and transect did not match. In other cases the transect, particularly on large delineations, did not indicate the area was incorrectly mapped even if the transect composition did not match the map unit description. For example, a transect on a map unit of Tunbridge-Berkshire complex may indicate a dominance of Berkshire along the transect line but an evaluation of the total area will shown that Tunbridge dominates.

The time required to run the assigned line transects reduced somewhat the amount of time that was available to make random traverses across larger areas of map units; however, this did not materially affect the overall evaluation of watershed mapping.

The RCC's overall impression of the mapping activities is that all involved personnel did a very careful and professional job and, based on the 20 percent sample, all watershed maps will meet the requirements of the DDRP mapping protocol.